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VOLUME XXVII.

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SYNTHESIS OF AROMATIC MONAMINES BY INTRAMOLECULAR ATOMIC INTERCHANGE.*

By A. W. HOFMANN, M.D., LL.D., F.R.S.

In a paper submitted to the German Chemical Society about a year ago, we proved (Dr. Martius and myself†) that the action of methylic alcohol on aniline chlorhydrate at a high temperature and under pressure, far from yielding exclusively methyl- and dimethylaniline, as has been formerly believed, is capable of causing methylation of the phenyl group, and thus producing quite a series of higher homologues of dimethylaniline.

If we endeavour to gain an insight into the mechanism of this reaction, we are led to assume that in the first instance the chlorhydric acid of the aniline salt gives rise to the formation of methylic chloride, which in its turn induces substitution, first in the ammonia fragment, and ultimately in the phenyl group itself. If, on the other hand, we remember that a tertiary monamine, such as must be formed by the final methylation of the ammonia fragment in aniline when submitted to the action of an alcohol chloride, is invariably converted into an ammonium compound, it must appear rather strange that in the process above alluded to only tertiary, and never any quartary bases are observed.

Under these circumstances the idea very naturally suggested itself of submitting the behaviour of quartary compounds at a high temperature under pressure to an experimental investigation.

The simplest compound that could be detected for such an inquiry appeared to be trimethylphenylammonium iodide, $C_6H_5.CH_3.CH_3.CH_3NI$.

Reserving for a future communication the experimental details of this inquiry, I will limit myself for the present to a brief statement of the principal result obtained.

Leaving secondary reactions out of consideration, the transformation of the trimethylated phenylammonium iodide is represented by the following equations :—

Transformation of quartary into tertiary compound.

$$C_6H_5.CH_3.CH_3.CH_3.NI = (C_6H_4.CH_3)CH_3.CH_3N.HI.$$

Transformation of tertiary into secondary compound.

$$(C_6H_4.CH_3)CH_3.CH_3.N.HI = C_6H_3(CH_3(CH_3)_2]CH_3.HN.HI.$$

Transformation of secondary into primary compound.

$$[C_6H_3(CH_3)_2]CH_3.HN.HI = [C_6H_2(CH_3)_3]HHN.HI.$$

Accordingly trimethylated phenylammonium iodide, when submitted to the action of heat, is transformed in the first place into iodhydrate of dimethylated methylophenylamine or dimethyl toluidine; this, in a second phase of the reaction, becomes iodhydrate of monomethylated dimethylophenylamine or xylidine, which in its turn is ultimately converted into iodhydrate of trimethylophenylamine, *i.e.*, of cumidine. The essential character of the reaction is thus seen to be an intermolecular change in the position of the methyl groups. According to the duration of the process, there are incorporated in the benzol nucleus, first the methyl group of the alcohol iodide, and then successively the two methylic groups which are stationed in the ammonia fragments. The action of heat on the quartary ammonium compound thus places at our disposal a simple means of rising from the benzol series itself to the toluol-, xylol-, and cumol series, or, generally (for the reaction may probably be utilised in many other cases), of passing from a less carbonated to a more carbonated series of compounds.

In carrying out the researches, the general results of which are sketched in the preceding paragraphs, rather considerable quantities of trimethylated phenylammonium iodide were consumed. This I obtained partly by methylating pure aniline with methyl iodine, partly by starting from commercial dimethylaniline, which was most liberally supplied to me by my friends Dr. D. Martius and Mendelssohn Bartholdy, having been specially purified for this purpose by Mr. G. Krell, by fractional distillation in the laboratory of the factory. This purified material was found to boil between 192° and 200°; and only few rectifications were necessary in order to obtain from it dimethyaniline in a state of perfect purity, identical in every respect with the base prepared by submitting trimethylated phenylammonium hydrate to distillation. Pure dimethylaniline is a liquid of 0·9553 V.W., solidifying to a crystalline mass at +0·5°, and boiling at 192°. The boiling-point was repeatedly determined, since it had been erroneously stated by M. Louth* to be 202°. The nature of the compound was ascertained by the analysis of the beautiful platinum-salt $2[C_6H_5(CH_3)_2N.HCl].PtCl_4$, crystallising in well-formed tables of considerable solubility.

In the early experiments trimethylated phenylammonium iodide was employed in the pure state, such as is obtained by crystallisation; subsequently, however, it was found to be quite sufficient if 1 mol. of dimethylaniline was mixed with 1 mol. of methyl iodide, and the compound thus produced at once submitted to the action of heat.

The quartary iodides may be exposed to a temperature of 200° for a considerable time without undergoing any alteration; but when heated for a day to from 220° to 230°, the salt is changed, the whole crystalline compound

* A paper read before the Royal Society.
† Hofmann and Martius, *Bericht*, 1871, p. 742.

* Louth, *Bull. Soc. Chim.* (2) vol. vii., page 448.

being transformed into an amber-yellow viscid mass, exhibiting no longer a trace of crystalline structure. If the temperature be then raised to the melting-point of lead (335°) a further change is manifested by the amorphous resinous substances having solidified again to a hard mass of large radiated, generally rather coloured crystals. On opening the digestion-tubes, appreciable quantities of uninflammable gas are evolved.

The products formed at moderate and extreme temperatures essentially differ from one another. This is seen at once when the iodhydrates produced in both cases are decomposed by alkali, and the bases thus liberated are submitted to distillation in a current of steam. The volatility of these bases shows the absence of quartary compounds; but whilst the monamines formed at moderate temperatures unite with acids to an extremely soluble salt, which are scarcely to be crystallised, those which are produced at high temperatures are found to solidify to rather difficultly soluble (readily crystallisable) salts with acids. The former bases exhibit the characters of *tertiary* and *secondary*, the latter ones those of *primary* monamines. Under these circumstances, it appeared desirable separately to examine the products formed in different conditions of temperature.

Examination of the Monamines formed at moderately High Temperatures.

On submitting the iodhydrates formed at 220°—230° to distillation with alkali, a basic oil is obtained, which, when rectified after drying over hydrate of potassium, boils between 200° and 280°. By repeated distillation, the boiling-point is considerably lowered, small quantities of substances boiling beyond the range of the thermometer being separated. Finally, by far the greater portion of the bases is found to pass between 186° and 220°. This liquid consists of two varieties of dimethyltoluidine, of methylxylidine, and small quantities of dimethylxylidine. Of the two dimethyltoluidines, the one has the V.W. 0·9324, and boils constantly at 186°: the other has the V.W. 0·9368, and boils at 205°, *i.e.* 19° higher than the former one. The nature of these two bases was fixed by the analysis of their platinum-salts,

$$2[C_6H_4.CH_3)(CH_3)_2N.HCl].PtCl_4,$$

and also of the quartary iodide, $(C_6H_4.CH_3)(CH_3)_3NI$, into which they were converted by the action of methyl iodides, and the platinum-salts corresponding to these iodide, $2[(C_6H_4.CH_3)(CH_3)_3NCl].PtCl_4$. The two dimethylated toluidines here described obviously correspond to two of the three modifications of toluidine, and very probably to the two liquid modifications. Dimethyltoluidine, obtained by converting solid toluidine into the trimethylated toluyl ammonium iodide, and then submitting the corresponding hydrate to distillation, has a V.W. 0·988, and boils at 210°. The substance thus obtained, the composition of which was also established by analyses of the platinum-salt, essentially differs from the isomeric base boiling at 186°; it is less easily distinguished from the base boiling at 205°, with which more particularly it much agrees in odour; in fact these two compounds exhibit only the slight difference of 5° in their boiling-point. Still I believe them to be isomeric, not identical.

It deserves to be noticed that while the boiling-point of solid toluidine (202°), by the introduction of two methyl groups, is raised by 8°, the boiling temperature of one of the liquid modifications (198°) is lowered by not less than 12°. Phenomena of this kind have been observed repeatedly in the course of this inquiry.

It was mentioned already that, in addition to the two dimethylated toluidines, the products of the action of heat on trimethylated phenylammonium iodide contains methylxylidine. I have not been able to isolate this compound; but it was not difficult to prove its presence by the action of methyl iodide on the mixed bases. The two dimethylated toluidines are thus converted into quartary iodides; but, together with these compounds, there is formed a tertiary iodhydrate, the base of which is readily separated by distillation of the product with an alkali. The base thus liberated has the V.W. 0·9293, and boils at 196°. Analyses of the platinum-salt proved it to be dimethylated xylidine,

$$C_{10}H_{15}N = [C_6H_3(CH_3)_2](CH_3)_2N,$$

which previous to methylation must have obviously existed in the form of monomethylated xylidine,

$$C_9H_{13}N.[C_6H_3(CH_3)_2]CH_3.HN.$$

The presence of methylxylidine being only indirectly proved by analysis of the dimethylated base, it appeared desirable to establish the nature of the latter by additional experiments. For this purpose the tertiary monamine was converted, by means of methyl iodide, into the quartary compound, the characters of which could not be mistaken, its composition being, moreover, established by analysis of the beautiful platinum-salts.

$$2[C_6H_3(CH_3)_2)](CH_3)_3NCl].PtCl_4.$$

In performing these experiments I was astonished to observe how difficultly dimethylxylidine combined with methyl iodide. Digestion at 100° produced no effect, and only heating the mixture for many hours to a temperature of 150° combination took place, but even then only to a very small extent.

It was this indifference of dimethylxylidine towards methyl iodide which enabled me to discover that small quantities of this compound are always formed, together with the monomethylated xylidine, when trimethylated phenylammoninm iodide is submitted to the action of heat. On treating the liquid, chiefly consisting of the two dimethylated toluidines and of monomethylated xylidine, with methyl iodide, these bases, as I have pointed out, are converted into iodine compounds; the small quantity of dimethylxylidine, which as such exists in the liquid, remains behind with the excess of methylic iodide, from which it may easily be separated by means of hydrochloric acid.

The formation of dimethylated toluidines and of monomethylated xylidine, requires no special explanation; it is due to intramolecular atomic interchange.

$$C_6H_5(CH_3)_3NI = (C_6H_4 . CH_3)(CH_3)_2 N.HI.$$
$$= [C_6H_4 . (CH_3)_2]CH_3HN.HI.$$

For the generation of dimethylxylidine it is necessary to supply a methyl group from without. I have, however, already pointed out that, along with the principal transformation, several secondary reactions are taking place; those I hope to examine more minutely by-and-bye. Dimethylxylidine, which occurs in comparatively small quantity, obviously belongs to such a secondary change. The complementary product is probably monomethyltoluidine,

$$[C_6H_5(CH_3)_3NI] = (C_6H_4.CH_3)CH_3HN.HI,$$
$$+ [C_6H_4.(CH_3)_2](CH_3)_2N.HI,$$

which I have not, however, as yet been able to trace.

Whilst engaged with these experiments, I have, for the sake of comparison, converted a specimen of xylidine obtained from aniline-oil of high boiling-point into dimethylxylidine. The xylidine employed had constant boiling at 216°. The tertiary base procured from it was observed to boil at 203°, *i.e.*, 7° higher than the compound derived from trimethylated phenylammonium iodide; from this last derivative it differed, moreover, by combining much more readily with methyl iodide. The quartary compound thus formed often remains liquid for days, and then suddenly solidifies into a beautiful mass of crystals.

Examination of the Monamines formed at High Temperature.

It has been already stated that the bases into which trimethylated phenylammonium iodide is converted at

very high temperatures (melting-point of lead), unmistakably exhibit the character of primary monamines. The only primary base which can arise from trimethylated phenylammonium iodide by intramolecular atomic interchange is a trimethylophenylated monamine, *i.e.*, a cumidine, $C_6H_5(CH_3)_3NI = [C_6H_2(CH_3)_3]H_2N.HI$. This, I may at once observe, is indeed the principal product of the reaction. It cannot, however, be wondered at that, under the influence of such extreme temperatures, many collateral changes must take place. The presence of dye-products is at once perceived, when the crystalline contents of the digestion tubes are submitted to distillation in a current of steam. Together with the vapour of water, a colourless oil is volatilised, consisting of hydrocarbons partly solid, partly liquid, the examination of which will form the subject of a future communication. Addition of an alkali to the liquid in the retort liberates considerable quantities of monamines, which, when dried over iodiamhydrate, are observed to boil between 225° and 260°. By repeated distillation this range of boiling is still considerably expanded; at the same time, by far the largest portion of the liquid is found to pass between 217° and 230°. The primary nature of this main fraction not only, but also of the bases, having both a lower and higher boiling-point, is at once manifested by the crystallising power and insolubility of the salts which they produce. At whatever stage of the distillation a drop of the liquid passing be mixed with dilute hydrochloric or nitric acid (invariably splendid), needles of chorhydrate or nitrates are formed, the solutions of which, even when considerably diluted, solidify with platinum perchloride double salts generally well crystallised. Another experiment rapidly indicating the primary character of these monamines may here be mentioned. On adding benzoyl chloride to the several basic fractions, much heat is evolved, and after cooling crystalline masses are produced, which are separated by water into soluble chlorhydrates and insoluble benzol compounds remaining behind, which may be crystallised from alcohol. None of the many secondary and tertiary monamines which have passed through my hands in the course of this inquiry exhibit this deportment, and accordingly benzoyl chloride may be recommended as a valuable reagent, readily applicable for primary bases. The method of recognising primary monamines which I have pointed out some time ago,* and which consists in converting them, by means of alcoholic potash and chloroform, into the powerfully smelling isonitrites, may also with advantage be resorted to.

The liquid boiling between 217° and 230° was separated by distillation into four fractions, each of which was then converted into a magnificently crystalline chlorhydrate. These several salts, after re-crystallisation, were all found to contain $[C_6H_2(CH_3)_3]H_2N.HCl$, and to yield platinum-salt of the composition

$$2\,[[C_6H_2(CH_3)_3]H_2.N.HCl]\,.PtCl_4.$$

I was thus led to believe that the fraction boiling between 217° and 230° consisted of several isomeric cumidines; but on separating the bases from the several chlorhydrates, it was found that they all contributed very nearly the same boiling-points. The liquid thus obtained boiled between 225° and 227°, and had the V.W. 0·9633; it did not solidify when exposed to a temperature of −10°. I am therefore inclined to assume that only one cumidine is formed by the action of heat on trimethylated phenylammonium iodide, and that the irregularities in the boiling-point of the original fraction must be due to the presence of small quantities of impurities.

It deserves to be noticed that cumidine obtained from aniline, when heated with corrosive sublimate, yields no trace of red colouring-matter, whilst a splendid crimson is at once produced if a mixture of this base with pure aniline be treated. I reserve for a future communication the study of the colouring-matter thus obtained.

* Hofmann, *D. Chem. Berichte*, 1870, p. 767.

Taking into consideration the general observations recorded in the preceding paragraphs, the compound here designated as cumidine was naturally assumed to be a primary monamine. Little doubt as this conception appeared to present, it had nevertheless to be proved by experiment; for this purpose the base was submitted to methylation. Cumidine is readily acted upon by methylic iodide at the common temperature. Since it was only necessary to establish the degree of substitution the first product of methylation was at once submitted to a second treatment; this second methylation likewise commenced at the common temperature, but had to be finished in the water-bath. The dimethylated base thus obtained has the V.W. 0·9076; it boiled between 213° and 214°; hence, in this case also, the insertion of two methyl groups had lowered the boiling-point. Dimethyl cumidine may be cooled to −10° without solidifying; like all tertiary monamines, it forms very soluble salts, but gives a very beautiful platinum salt, containing

$$2\,[[C_6H_2(CH_3)_3](CH_3)_2N.HCl]\,.PtCl.$$

Remarkably enough, dimethylated cumidine exhibits the same reluctance to form a quartary compound with methyliodide that has already been pointed out as a peculiarity of the tertiary xylidine. But whilst in the case of dimethylxylidine, though difficultly and sparingly, combination after all took place, all attempts with dimethylated cumidine have hitherto failed. The base was heated with methylic iodide for days in the water-bath, and ultimately even to 150° without any result. This inability of forming quartary compounds must in one way or another depend upon the arrangements of the material within the molecule. At all events, it deserves to be noticed that there are dimethylated xylidines and cumidines which readily combine with methyl iodide. The dimethylated bases existing in the less volatile fractions of commercial dimethylaniline, all form quartary compounds without difficulty, and must therefore correspond to xylidines and cumidines, which differ from those derived from trimethylated phenylammonium iodide.

In what relation stands the cumidine above described to the cumidines already known? Of the several purely methylic cumidines which are possible, two only are somewhat accurately known; these are the two bases, which are derived, the one from so-called pseudocumol (obtained by treating xylilic bromide and methylic iodide with sodium), the other from mesitilol. The former cumidine is a solid, fusing at 62°, and need not therefore be further considered here. Most probably the cumidine above described will prove identical with the primary monamine corresponding to mesitilol. Unfortunately, mesitylamine has been hitherto so little studied, that even its boiling-point is not known. I hope next winter to examine more minutely this group of compounds.

In conclusion, I have great pleasure in expressing my best thanks to Mr. E. Mylius, assistant in the Berlin Laboratory, for the zeal and care with which he has furthered the progress of these researches.

NEW METHOD FOR PRODUCING AMIDES AND NITRILES.*

By E. A. LETTS, Berlin University Laboratory.

SOME time since Professor Hofmann† has shown that phenyl mustard-oil, when acted on with acetic acid under pressure, is converted into phenyl-diacetamide, carbonic anhydride and sulphuretted hydrogen being separated—

$$\left.\begin{matrix}CS\\C_6H_5\end{matrix}\right\}N + 2(C_2H_3O\text{-}OH) = \left.\begin{matrix}C_6H_5\\(C_2H_3O)_2\end{matrix}\right\}N + CO_2 + H_2S.$$

Bearing this reaction in mind, the question arose as to

* A Paper read before the Royal Society.

† Hofmann, *Beriche. d. Deutch. Chem. Gessell.*, 1870.

how the metallic sulphocyanates would behave under similar circumstances; at Professor Hofmann's suggestion I have submitted this question to an experimental investigation.

Action of Acetic Acid on Potassium Sulphocyanate.

Supposing the potassium salt of sulphocyanic acid to undergo a change analogous to that observed with the phenyl mustard-oil, it was to be expected that 1 molecule of this body would react with 3 molecules of acetic acid to produce 1 molecule of potassium acetate and 1 molecule of diacetamide, carbonic anhydride and sulphuretted hydrogen being evolved—

$$KCNS+3(C_2H_3O\text{-}OH)=$$
$$=C_2H_3O\text{-}OK+(C_2H_3O)_2HN+CO_2+H_2S.$$

The reaction, however, takes a different course.

In my first experiments the acetic acid was allowed to react on the sulphocyanate under pressure; but it soon became evident that this was unnecessary, simple digestion of the two bodies in a flask provided with an upright condenser being amply sufficient.

The powdered salt dissolves readily in the boiling acid, and an immediate and copious disengagement of gases ensues, in which carbonic anhydride and sulphuretted hydrogen may be readily recognised. Considerable time, however, elapses before the sulphocyanide is completely decomposed, some three or four days being required for a mixture of 100 grms. potassium sulphocyanate and 180 grms. acetic acid. At the end of this time the products of the reaction were submitted to distillation and commenced boiling at 170°-180°; the thermometer, however, rose rapidly to 216°; and between this temperature and 220° the distillate solidified in the receiver to a radiating crystalline mass, which analysis showed to be pure *acetamide*‡. Above 220° nothing further distilled, the residue in the retort consisting wholly of potassium acetamate. In what manner had acetamide been formed, instead of diacetamide expected in the reaction? It appeared not unlikely that the acetic acid employed contained some water, and that the diacetamide produced in the first instance was thus converted into the mono-compound—

$$\left.\begin{matrix}(C_2H_3O)_2\\H\end{matrix}\right\}N+H_2O=C_2H_3O\text{-}OH+\left.\begin{matrix}C_2H_3O\\H_2\end{matrix}\right\}N.$$

To remove any water which might possibly have been present, the acetic acid was treated with phosphoric anhydride, and the experiment with the sulphocyanate repeated; but even now acetamide was exclusively obtained.

On submitting, however, the gases evolved during the reaction to a closer examination, the formation of acetamide became at once intelligible. It was found that a large proportion of these gases consisted of carbonic oxysulphide (COS). To prove the presence of this compound, it was only necessary to pass the evolved gases through a bottle containing a slightly acid solution of lead, by which the sulphuretted hydrogen was retained: thus purified, they produced no further precipitate when passed through a second bottle containing the same solution; but precipitation at once took place if this solution were rendered alkaline by soda or ammonia. This is the characteristic behaviour of carbon oxysulphide, which was further identified by its odour, great density, and inflammability.

The principal reaction that takes place when acetic acid is treated with potassium sulphocyanate is accordingly as follows:—

(1) $KCNS+C_2H_3O\text{-}OH=C_2H_3O\text{-}OK+HCNS,$
(2) $HCNS+C_2H_3O\text{-}OH=C_2H_3O\text{-}N\text{-}H_2+COS.$

‡ The liquid products passing over before 216° yield considerable quantities of the amide on fractionation; this remark applies to the other experiments with *the fatty acids* to be presently described.

The sulphuretted hydrogen and carbonic anhydride, produced simultaneously with the carbonic oxysulphide, are the complements of a second reaction; the principal product of which I have not the least doubt is *acetonitrile*.

$$\overset{\text{III}}{C_2H_3O}\text{-}\overset{\text{V}}{N}\text{-}H_2+COS=C_2H_3N+H_2S+CO_2.$$

I must remark, however, that I have not actually proved the formation of this body by experiment. My investigations in the acetic series were completed before this phase of the reaction was thoroughly understood, and thus, probably owing to its low boiling-point (77°), the acetontrile had been carried off with the stream of disengaged gases, and had escaped detection. I have not repeated the experiment, because in other series it has been easy to demonstrate the formation of the nitrile.

Action of Isobutyric Acid on Potassium Sulphocyanate.

If potassium sulphocyanate be heated with isobutyric acid (which may now be readily obtained in a state of purity by oxidation of the isobutyric alcohol separated from fusel oil), the salt melts under the acid to an oily layer, from the surface of which bubbles of gas are plentifully disengaged, consisting, as in the preceding case, of carbonic oxysulphide, carbonic anhydride, and sulphuretted hydrogen. In consequence of higher boiling-point of isobutyric acid (154°), the reaction proceeds more rapidly than with acetic acid. If the mixture be submitted to distillation when all disengagement of gas has ceased, it begins boiling a few degrees above 100°, the thermometer rapidly rising to 216°; during this time an aromatic liquid passes over, possessing the odour of butyric acid.

Between 216° and 220° the thermometer remains tolerably constant, the distillate solidifying in the receiver to a white crystalline mass. On fractionating the liquid portion passing over before 200°, no product can be obtained showing a constant boiling-point; but on treating it with a solution of caustic soda, an oily aromatic liquid of characteristic odour floats on the surface, which, separated by a large funnel and dried over calcium chloride, boils constantly between 107° and 108°. Its composition and reactions characterise this substance as isobutyronitrile.

$$C_4H_7N=\begin{matrix}H\text{-}C\text{-}(CH_3)_2\\|\\CN\end{matrix}$$

	Theory.		Experiment.
C_4	48	69·56	68·93
H_7	7	10·14	10·53
N	14	20·30	——
	69	100·00	

Boiled for some time with an alkali, this nitrile is converted into isobutyric acid and ammonia. The complementary products attending the production of this body are carbonic anhydride and sulphuretted hydrogen, whose copious evolution have already been mentioned.

$$HCNS+C_4H_7O\text{-}OH=C_4H_7N+CO_2+H_2S.$$

Isobutyronitrile has been prepared by Merkownikoff.* He obtains it by treating isopropyl iodide with cyanide of potassium, but probably not in a state of purity, as he gives 80° as its boiling-point; whereas 107° to 108°, the number obtained by myself, approaches more closely that observed for the normal butyronitrile (114°). The crystalline substance before described as passing over between 216° and 220° is the amide of isobutyric acid—

$$C_4H_9NO=\left.\begin{matrix}C_4H_7O\\H_2\end{matrix}\right\}N=\begin{matrix}H\text{-}C=(CH_3)_2\\|\\O=C\text{-}N=H_2.\end{matrix}$$

* Merkownikoff, *Jahresb.*, xviii., 318.

The analysis gave—

	Theory.		Experiment.
C_4	48	55·17	54·86
H_9	9	10·35	10·45
N	14	16·09	
O	16	18·39	
	87	100·00	

Isobutyramide forms a white crystalline mass of pleasant aromatic odour; it fuses between 100° and 102°, and when heated somewhat above this temperature, but far short of its boiling-point, sublimes in beautiful iridescent laminæ. It boils between 216° and 220°, and distils without the slightest decomposition. It dissolves readily in water and alcohol, and slightly in ether. Isobutyramide is the principal product of the action of isobutyric acid on potassium sulphocyanate.

$$HCNS + C_4H_7O\text{-}OH = \left.\begin{matrix} C_4H_7O \\ H_2 \end{matrix}\right\} N + COS.$$

200 grms. of the acid yielded 60 grms. pure amide.

Isobutyramide—

$$H\text{-}C\text{-}(CH_3)_2$$
$$O = C\text{-}N = H_2,$$

distinguishes itself from the normal amide—

$$H_2 = C\text{-}CH_2\text{-}CH_3$$
$$O = C\text{-}N = H_2,$$

by its lower melting-point. The iso-compound fuses between 100° and 102°, whereas the normal butyramide melts at 115°. The boiling-point is much the same for both.†

Action of Valeric Acid on Potassium Sulphocyanate.

In this instance, too, the reaction proceeds according to the two equations—

$$HCNS + C_5H_9O\text{-}OH = C_5H_9N + CO_2 + H_2S,$$
$$HCNS + C_5H_9O\text{-}OH = \left.\begin{matrix} C_5H_9O \\ H_2 \end{matrix}\right\} N + COS.$$

The separation and purification of the valeronitrile and valeramide is similar in all respects to that employed for the corresponding compounds in the butyric series. Valeronitrile, already investigated by other chemists, boils between 125° and 128°. By treatment with fumic nitric acid, it is converted into a crystalline substance (perhaps $C_5H_8(NO_2)N$), which I have not as yet been able to examine further.

Valeramide closely resembles the isobutyramide. It is a white crystalline body of pleasant aromatic odour, recalling that of the valerian root: it is soluble in water, alcohol, and ether; in the last-mentioned liquid much more so than the isobutyramide. From hot water it crystallises in large right-angled but very thin plates. Valeramide fuses between 125° and 128°, and sublimes in the same manner as isobutyramide below its boiling-point, which lies between 230° and 232°. It distils without decomposition.

Action of Benzoic Acid on Potassium Sulphocyanate.

The aromatic acids, $C_nH_{(2n-8)}O$, series react in an analogous manner with potassium sulphocyanate, with the difference, however, that here nearly exclusively the nitrile is formed. The production of amide is so insignificant as to be scarcely recognisable. The reaction with *benzoic acid* takes place with particular facility according to the equation—

$$HCNS + C_7H_5O\text{-}OH = C_7H_5N + CO_2 + H_2S.$$

2 mols. benzoic acid and 1 mol. potassium sulphocyanate (both in a perfectly dry condition) are placed in a retort, to the mouth of which a long wide tube is attached to serve as condenser. The apparatus thus arranged is placed vertically, and heated either in a paraffin-bath or over the naked flame. Both bodies melt, forming two layers, of which the benzoic acid is the lower. At 190° the reaction commences, carbonic anhydride and sulphuretted hydrogen being evolved. At a higher temperature the mixture enters into ebullition, and in about half an hour swells to a solid mass. The retort is now reversed, and the contents strongly heated; they melt, boil, and yield a semi-solid distillate. The distillation is carried on as far as possible without charring the residue, which consists of potassium benzoate, from which half the benzoic acid employed may be covered. By addition of ammonia to the semi-solid distillate the acid is retained, whilst the nitrile distils with the water, from which it is afterwards separated, dried, and re-distilled. A roughly carried out experiment yielded 80 per cent of the theoretical quantity of nitrile in a perfectly pure condition; the loss owing to secondary reactions is amply compensated by the ease and rapidity of the operation.

Action of Cuminic Acid on Potassium Sulphocyanate.

An experiment with cuminic acid yielded very satisfactory results: cumonitrile was obtained in about the same proportions as the benzonitrile. The temperature at which reaction commenced was here about 211°; the nitrile was purified as in the preceding case.

Finally, an experiment was made with cinnamic acid; but although sulphuretted hydrogen was evolved, and the reaction appeared to proceed quite as in the foregoing cases, no tubuli was obtained in the liquid distillate. The cinnamic acid seemed to be decomposed into carbonic anhydride and cinnamol before becoming acted upon by the sulphocyanic acid.

The ease with which so many nitriles and amides are obtained, both in the aromatic and fatty series, induces me to hope that the new method may be of use in many cases, and perhaps by its application to other series give rise to bodies hitherto uninvestigated.

The tediousness of preparing the acid chloride, and subsequent treatment with ammonia (for the amide) or phosphoric anhydride (for the nitrile) in the ordinary method for producing these nitrogen compounds, is here replaced by simple digestion of the acid with sulphocyanate of potassium, bodies generally readily procurable.

† It is remarkable that acetamide, butyramide, and isobutyramide all have the same boiling-point, namely, 216° to 220°.

MINERALOGY.

The sixth and concluding lecture of the course to working men, by Mr. W. W. Smyth, F.R.S., delivered on Monday evening, December 16, was on "The Ores of Iron and their Various Modes of Occurrence."

The lecturer commenced by drawing attention to the vast importance of the iron trade to the well-being of this country, the yield of ore during last year being no less than 17,000,000 tons. The percentage composition of some of the principal iron ores was given as under:—Magnetic iron ore—Fe 72·4, O 27·6; specular iron ore, or red peroxide of iron—Fe 70, O 30; brown iron ore, or hydrated oxide of iron—Fe 60, O 26, H_2O 14; sparry iron ore, or carbonate of iron—FeO 62, CO_2 38.

Magnetic iron ore, or "magnetite," received its name in early times from its magnetic properties. These the lecturer illustrated by means of a magnetic needle, a mass of the ore influencing the needle at a great distance. The magnetism of the ore was shown to be polar, the same side which repelled one end of the needle attracting the other, and *vice versa* with the other side. It crystallises in the cubical system, the octahedron and rhombic dodecahedron being common forms. It occurs in Sweden, Norway, the Ural Mountains, &c., and on a very much smaller scale in England. In the south-east corner of

Dartmoor, a band of this kind of ore deranges a compass as it is carried past its vicinity, and sailors say that there is a place in Cardigan Bay, where on passing a reef of rocks the needle is influenced, and set oscillating. A large mass of this deposit in the south-east extremity of the Island of Elba has a similar effect; in Sweden, too, deposits are discovered by means of this property. Meteorites frequently contain a percentage of iron greater than magnetite, associated with nickel and chrysolite in some cases, but the rarity of their occurrence precludes them from being classed as iron ores, by which term we understand a mineral containing iron in sufficient quantity as to be economically and advantageously extracted.

Specular iron ore occurs in this country on a far larger scale than the preceding variety, the greater proportion of which (either as ore or metal) we have to import from Sweden. The crystalline form of this ore belongs to the hexagonal system, the crystals being, as a rule, tabular. It occurs usually of a bluish black colour, sometimes a brownish red, at others with an iridescent film; while large crystals (as some of these from Brazil) occur occasionally with a lustre so great as to have obtained for it the name of specular or looking-glass ore. But the bulk of the ore, as found in this country has a rounded or mammilated form, and hence is known as "kidney ore," while from its deep rich red colour in some varieties, it is known as hæmatite, or blood-stone. These ores may be readily distinguished from the magnetic by their giving in all cases a red powder when scratched or powdered, whereas the magnetic always give a black powder. They occur especially in the northern districts of England, the districts of Furness and West Cumberland being notably rich. The produce of the mines in those districts for last year was—Furness, 931,000 tons; Cleator, 976,874 tons; Hodbarrow, 207,146 tons; making a total of 2,115,000 tons, the value of which as ore being, in round numbers, £2,500.000. It likewise occurs in the Island of Elba (notably round Rio, where many of the rocks quite spangle in the sun with scales of this ore), Bilbao in Spain, Saxony, and North America.

The brown ore, or hydrated oxide, is distinguished from the other varieties by giving a brown powder, and this whatever its external appearance. The quantity of water varies considerably; it is usually from 10 to 15 per cent. It is driven off by a process of calcination—in other words the ore is roasted. It occurs chiefly in our western mining districts, South Wales, and the Forest of Dean. In some cases it occurs in irregular cavities in the strata, with the appearance of having been deposited in them much in the manner of stalactites. The stratified deposits of this ore, occurring in strata belonging to the secondary formation in the midland counties, have only lately had much attention devoted to them, but they will probably come more and more into play as the deposits of superior ore fall away. The town of Middlesborough, and those in its neighbourhood, owe their rapid rise and development entirely to valuable deposits of these ores—Cleveland ores—discovered a few years ago in the neighbourhood.

Spathose, or sparry iron ore, known as "white iron" ore by the miners on accout of its light colour, is generally found mixed with carbonates of lime, magnesia, &c. Some rhombohedral crystals are found of a pale yellow colour, though the general colour of it varies considerably. It occurs in marked abundance in England, and also in Germany, Austria (at Styria it has been worked for many hundred years), and other places. In England its principal mode of occurrence is in the form of nodules, mixed with much clay, whence the term "clay ironstone." It is found in beds or layers, interstratified with the various strata of the coal measures. The nodules contain in some cases as much as 30 per cent of the metal; when split they frequently present patterns of crystallised substances, which have been introduced into the mass by infiltration, and deposited in the cracks which have been formed in the mass by shrinkage. "Black band" iron ore is a variety of argillaceous ore which has of late years been employed in Scotland; it owes its colour to associated carbonaceous matters, which prove of great use in calcination by diminishing the supply of extra fuel required.

There is one more mineral which is important as yielding iron, but which has only lately been utilised for the purpose, being formerly thrown away as worthless. This is iron pyrites, a compound of iron and sulphur. When, in 1840, the King of Sicily partially prohibited the export of sulphur from that island, the attention of chemists was directed towards this mineral, with the hope of extracting that material from it. Even after means were found for doing this, the remainder still remained unemployed till at length means were discovered which enabled us to obtain not merely the iron, but also to extract a small proportion of copper, and also a minute quantity of silver which occurs in the mineral. Large quantities are obtained from Ireland and from Spain and Portugal.

UNUSUAL AMOUNT OF AMMONIA IN A SO-CALLED SPA WATER.

By CHARLES A. CAMERON, M.D.,
Professor of Hygiene, Royal College of Surgeons, Ireland;
Analyst to the City and County of Dublin, &c.

A SPRING situated at Portobello, a suburb of Dublin, has been for many years in some repute as a sulphur spa, and wonderful cures have been attributed to the use of its waters. I have recently analysed it on behalf of the local authorities, and its composition is so peculiar that I think it worth while to publish it. An imperial gallon contains—Solid matters (chiefly calcic carbonate), 24·236 grains; chlorine, 1·11 grains; organic nitrogen, 0·0035 grain; organic carbon, 1·26 grains; ammonia, 0·562 grain; hydric sulphide (all, except a trace, combined with ammonia), 0·406 grain; nitrites and nitrates, faint traces. Five gallons, evaporated nearly to dryness, gave a remarkable jelly-like residue. The water is clear, of a very light yellowish green colour, and has an odour of sulphuretted hydrogen, which passes away after an hour or two. Only minute quantities of iron and silica are present, and there are no sulphides, except the ammonic sulphide.

There is nothing in the water to account for its reputed medicinal qualities; but the enormous amount of ammonia which it contains, when compared with the minute quantity of albumenoid nitrogen, is very remarkable.

ON SOIL ANALYSES AND THEIR UTILITY.*

By EUG. W. HILGARD, State Geologist of Mississippi.

IN the *American Journal of Science* for September, 1861, Prof. S. W. Johnson published a criticism on the "Soil-Analyses of the Geological Surveys of Kentucky and Arkansas," whose strictures, to a great extent eminently just, appear to have so impressed the scientific public in this country, that few if any soil-analyses have since then been made in connection with any state or national survey, excepting that of the State of Mississippi, where the work already begun was continued, either by myself, or under my charge, or recommendation, by others. Holding myself responsible for this departure from the generally adopted views, I propose in the present paper to discuss specially Prof. Johnson's objections, and to give my reasons for persisting in a course of research that has, more than once, secured for myself and my co-labourers

* Read at the Dubuque Meeting of the Am. Assoc. Adv. Sci., August, 1872.

the compassionate sympathy of true believers. While I consider the work far from being as complete as it should be, and for that as well as other reasons its publication in detail may be delayed for some time, yet I think what can now be said of sufficient importance to be brought before this meeting.

I propose, in this discussion, to maintain the mainly practical standpoint assumed by Prof. Johnson himself. I shall therefore leave out of consideration the performance of such exhaustive investigations of *all* the physical and chemical properties of the soil, as have been made in some cases, for special purposes, *e.g.*, by Prof. Mallet, on some of the cotton soils of Alabama. If the investigation of each soil, to possess practical importance, requires from three to six months labour, we may as well, for practical purposes, consider such researches out of the question for the present. We want something analogous to the metallurgical assay of minerals, as distinguished from their complete ultimate analysis. So far, therefore, as the agricultural qualities of a soil may be inferred and approximately estimated by an experienced eye, I would relieve the chemist from the exact numerical determination, *e.g.*, of the power of absorbing heat from the sun, the specific heat, the "water-holding" power, the capillary coefficients, &c. However necessary for theoretical investigations, I hold that, for practical purposes, these laborious determinations may in most cases be dispensed with; since from what has already been done, or what can be done with a few typical soils, we may infer the comparative magnitude of these coefficients with a sufficient degree of approximation.

The amount of labour bestowed on each soil by Dr. Peter, as reported in the Kentucky and Arkansas surveys, approaches very closely the limit beyond which the *immediate* advantages to be derived from such knowledge of soils as analysis may impart, would seem, to many, disproportioned to the expenditure involved. How very modest we are, truly, when a purely scientific object is involved, whose immediate practical apptication is not obvious at a glance! In what other branch of technical science would it be thought admissible to proceed without obtaining such knowledge of the prime materials as chemistry may afford, even if no immediate application of this knowledge be foreseen? Our public treasuries are constantly drawn upon for hundreds of thousands of dollars, in behalf of objects of at least questionable usefulness. Yet Prof. Johnson seems to have thoroughly satisfied our state geologists that they are not justfied in giving the virgin soils of their respective States the benefit of such light as chemistry may even now confessedly afford; apart from the important general inferences which may fairly be expected to be drawn hereafter from the history of their cultivation. How are we to advance in our knowledge of soils if we abandon as hopeless the determination of their chemical character? Are the proofs that have been brought against the utility of soil analyses really of such a character as to justify so grave an omission? an omission, too, which in many cases cannot hereafter be supplied. Even in the comparatively youthful State of Mississippi, I have found difficulty in obtaining reliable specimens of some soils, whose great productiveness had led to their cultivation by the earliest settlers, over the entire area of their occurrence.

I question the propriety of this omission, and the justice of the *testimonium paupertatis* thus inflicted upon agricultural and analytical chemistry.

To define my position, I premise that—

1. I fully agree with Prof. Johnson as to the comparative uselessness of a single analysis giving the percentages of soil ingredients found, in ordinary cases. It is only when such analysis demonstrates the great abundance, or very great deficiency, of one or several primarily important ingredients, that, by itself, it conveys information of considerable practical importance. Note that such cases are not altogether infrequent, even in virgin soils.

2. I agree that an "average soil" is *a non ens*, except as referred, comparatively, to a particular set of soils closely related in their origin.

3. Also, that the claim of being able to detect the minute differences caused by cropping without return to the soil, is precarious, and perhaps beyond the power of our present analytical resources.

4. I further admit that, ordinarily, the analysis of soils long cultivated, and treated with manures, can give but little and very partial information as to the condition and composition of the soil; from the great difficulty, if not impossibility, of obtaining fair representative specimens.

5. Furthermore, that to designate soils by the names of the Cretaceous, Carboniferous, or Silurian strata they may happen to overlie, is very loose practice; since in most cases they are derived from Quaternary deposits, which may or may not have been influenced in their composition by the subjacent rocks.

On the contrary, I demur, in the first place, to the broad assertion that "it is practically impossible to obtain average specimens of the soil," as inapplicable to a very large class, especially of virgin soils, covering large areas with a uniformity of character corresponding to that of subjacent formations, from which they have been directly derived, by substantially identical and uniform, or uniformly variable processes.

The importance of this exception is not, it is true, very obvious in the stony fields of New England (such as discouraged Prof. Johnson in his vacation trip to Northern New York), or in fact, in any district where a great variety of formations has directly contributed toward forming the soil, and "chunks" of undecomposed minerals are diffused through it. In such cases, the analysis of the rock which has predominantly contributed to the mass of the soil proper, would be a more correct index of the prevalent characteristics of the latter than if itself were taken in hand. And from such analyses we could at least deduce what ingredients, and in what form, it would certainly be useless to add to the soil.

But when we come to the great plains of the West and South-West, whose soils are consistently derived from wide-spread quaternary deposits, composed of materials almost impalpable, save as regards siliceous sand, or even the rolling uplands of the Gulf States, whose subsoil stratum of "yellow loam" can only be diluted, but not otherwise changed, by the admixture of the underlying drift, leached long ago of everything soluble in carbonated water or available to plants: the objection based upon the supposed impossibility of securing representative specimens, becomes obviously untenable, as I shall hereafter show from the close correspondence in the composition of soils, and especially *sub*-soils, from widely distant portions of the State, derived from the same geological (quaternary) stratum.

A word in regard to the "freaks and accidents" mentioned by Prof. Johnson as liable to make sport of the devoted analyst. Undoubtedly such errors must be ultimately provided against by multiplication of analyses (not necessarily of the same acre, but of other corresponding specimens, in the sense mentioned above); and while questioning the efficiency of a bird or squirrel in vitiating a properly taken sample of soil, I must admit the disastrous consequences which might result if a dog, cow, or horse were similarly concerned. No specimen of "virgin soil" can, of course, be obtained where such animals usually do congregate. But, as a rule, it is not all difficult to avoid such places; while the chance of accidentally hitting upon a sporadic animal deposit in the broad woods or prairies is singularly small, and is notably diminished by the circumstance, that an attentive observer (and none other should take soil specimens) will be able to distinguish such localities for years, by the peculiarity of their vegetation. I will remark, however, that I consider the sampling of a soil with a view to securing a representive specimen, as a matter second in difficulty and delicacy only to the analysis itself; that I rarely have thought it worth while to analyse specimens sent by other than

intelligent persons specially instructed by me; and even then have frequently had to reject them, from their having obviously been taken at an improper locality, e.g., near a footpath, by the side of a fence, on a partially denuded hillside or ravine, in the bed of a run, at the foot of a tree, &c.

The question of *depth* must, in my view, be left to be determined by the circumstances of each case, except in so far as the extreme depth to which tillage may cause the roots of crops to reach, must be within the limits of the samples taken. Of these, *one* should ordinarily represent what, under the usual practice of tillage, becomes the arable soil; another the subsoil not usually broken into; a third will in most cases be useful to show what materials would be reached were the land to be underdrained. As a rule, I have taken no specimens of soil to a less depth than six inches, and as much deeper as uniformity of colour reached—for obvious reasons. But in special cases, when important differences were suggested by the aspect of the soil and subsoil, they have been separately examined, at whatever depth the change of colour might occur.

With soils of the character referred to, samples selected and taken with due care, and strict attention to thorough intermixture, both in the field and subsequently in the laboratory, I am unable to see why even two grammes may not correctly represent the characteristics of a 1000 acre tract. Not that every point of that tract would be likely to give the same percentage result, perhaps, especially as regards the surface soil, which might in places be more clayey or more sandy than the sample analysed. Still, the relative proportions of the soil ingredients, and their degree of availability, would remain substantially the same; the wider range and readier penetration of roots in sandier soils, making up, within certain limits, for the smaller percentage of available ingredients in a given bulk, as compared with more clayey ones.

From the fact that the atmospheric surface water must, in its course, inevitably have a tendency to bring about such inequalities, by carrying forward the finer particles of the soil in larger proportion than the coarser ones, as well as from the greater influence of vegetation, we shall, in the series of analyses, made a postulate by Prof. Johnson, expect to find a closer agreement between those of subsoils than those of surface soils. Such I find to be very decidedly the case; so much so that I habitually look to the former as the most reliable index of a soil's distinctive character. To this there can be no legitimate objection, when, as in all the upland soils now under consideration, the surface soil is directly derived from the subsoil, and its depth is less than thorough culture would give to the arable soil.

As regards the analysis itself, I premise that I have always found even the most "chemically pure" reagents sold by dealers quite inapplicable to the purpose of soil analysis. From first to last, I have prepared or purified these myself; and, as regards the acids, especially hydrochloric, I have found it necessary to reject, as a rule, even the purest, after keeping it for a few weeks in a glass bottle. The same is true, and perhaps in an aggravated degree, of aqua ammoniæ. The severe ordeal of slow evaporation on a bright platinum foil will rarely be passed by ammonia a fortnight old; and still less frequently by hydrosulphide of ammonium.

Armed with these, and a multitude of other precautions, usual and unusual, to secure the utmost possible accuracy; always treating the soil with the same large excess of acid of uniform strength, and precipitating all corresponding precipitates as much as possible from the same volume of liquid; using none but the best Bohemian glass, and platinum vessels, and filters specially extracted—operating, in short, as uniformly as the nature of the materials would permit: I confess I felt considerable confidence in the correctness of my results, until the experiments made in Bunsen's laboratory, on the solubility of glass vessels, gave rise to unpleasant doubts. On consideration, however, I found that the (sensibly constant) error so introduced would not, when allowed for, amount to more than the differences between two analyses of one and the same material, or vitiate in any serious degree the conclusions arrived at. Nevertheless, I shall hereafter, to the utmost possible extent, carry on all operations liable to introduce errors on this score, in platinum and porcelain vessels. as advised by Bunsen.

As regards Dr. Peter's failure to determine the amounts of soluble silex, nitric acid, ammonia, chlorine, and the degree of oxidation of the iron, I agree that the former is desirable, not only because, whether "essential" or not, some plants do habitually absorb it in very large quantities, and it might be best to let them have it; but also because it is a desirable index of the degree of decomposition which the soil silicates have undergone. I have therefore made this determination regularly, by boiling with solution of sodium carbonate. In a series of these determinations, an unmistakable relation between the soluble silex and the amount of lime in the soil becomes manifest; as might, indeed, have been foreseen.

As regards nitric acid, the consideration suggested by Prof. Johnson himself, viz., that its quantity must be exceedingly variable, within short periods, in one and the same soil, seems to me a sufficient dispensation from the laborious determination.

The same holds good, in a measure, for ammonia. Its quantity varies continually in the soil, as it does in the atmosphere; its chief absorbers in the soil are "humus" and clay. Where these prevail largely, ammonia can scarcely be deficient as a nutritive ingredient to an injurious extent; albeit, more might doubtless be beneficially added. Moreover, the characteristic effects of ammonia on vegetation are sufficiently obvious (in "running to weed") to render its determination in virgin soils, laborious and even uncertain as it is, a matter of comparatively little practical consequence, however great might be its theoretical interest.

As for the determination of the degree of oxidation of iron, I confess I fail to see its practical bearing. When ferric oxide is present, plants surely can have no difficulty in reducing the modicum they need to a soluble condition. When ferrous oxide exists to any great extent, it indicates a want of drainage, and manifests itself both in the colour of the soil and in the poisonous effect on vegetation. But farmers surely do not need the aid of chemical analysis to tell them that their soil needs drainage and aëration! A determination made to-day would be of no value to-morrow, if the soil had been ploughed in the interval.

Finally, Dr. Peter *does* determine *chlorine* in the treatment of soils with carbonated water, though it is not put down in the general analysis. However, the soluble chlorides, like the nitrates, are so constantly liable to variation, and, as experience shows, so little likely to be deficient in the soil, that its omission would not be a serious practical objection.

[To be continued.]

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, December 10th, 1872.

J. P. Joule, D.C.L., LL.D., F.R.S., &c., President, in the Chair.

"*Observations of the Meteors, observed on November 27th, 1872.*"

1. By E. W. Binney, F.R.S., F.G.S.—On the 27th November last, at Douglas, in the Isle of Man, my

attention was called by an inmate of my house to numerous meteors in the sky. On going out of doors about 7.45 p.m., they were seen radiating from a point in Andromeda and falling in all directions towards the horizon, some not proceeding far down before they disappeared, whilst others travelled to a much greater distance. The sky was perfectly clear for three hours, during which time I observed them, and they appeared in all directions to be equally numerous except during the last hour. Some were as large as a star of the first magnitude and others were only just perceptible. Nearly all of them appeared to leave tails in their course, which were generally straight, but some of them were curled. In colour most of them were white or yellowish white, but some of the larger ones were of a reddish tinge. At about 7.45 p.m. six were noticed at one time. At 8.45, on looking at about a quarter of the space of the heavens, towards the west, I counted during a minute 21, 11, 24, and 12 respectively. This would give an average of 17 per minute; assuming that the other three portions of the heavens afforded as many, and to me the meteors appeared to be about equally dispersed, so there would be probably about 68 per minute during the two first hours I observed them. At eleven o'clock they were still falling, but not so numerously. The early part of the evening was rainy, but it cleared up shortly before seven, and I am informed that meteors were then observed.

On the 3rd December inst., at 8.45 p.m., there was visible an aurora in the form of a beautiful arch of a yellowish white colour, extending from east to west, and reaching up to the lower parts of *Ursa Major*. A slight trace of streamers was seen on the top of the arch.

2. By Joseph Baxendell, F.R.A.S.—The early part of the evening of the 27th of November was cloudy, and the meteors were not seen till about 10 minutes to 7, when a partial clearing occurred. It soon became evident that they belonged to a distinct meteoric stream, and my attention was therefore chiefly directed to the determination of the position of the radiant point. The observations were, however, frequently interrupted by clouds, and at no time was the sky entirely cloudless. The intervals of observation and the number of meteors whose tracks were observed with sufficient precision to be of use in the determination of the position of the point of divergence were as follows:—

h. m.		h. m.		Number of Meteors.
6 53	to	7 9	G. M. Time.....	65
7 21		7 51	.....	51
8 1		8 15	.....	8
8 31		8 34	.....	9
8 49		9 2	.....	31
11 21		11 27	.....	7
11 33		11 51	.....	7
12 7		12 19	.....	10

The total number was 271, and of these 266 had the points of intersection of their paths in an elliptical area of 12 degrees long and 8 or 9 degrees broad, the centre of which was in right ascension 22¼ degrees, and north declination 44½ degrees, near the small star Chi Andromedæ. Three of the remaining five had their radiant point in the constellation Cassiopeia.

The average brightness of the meteors was equal to that of a star between the 3rd and 4th magnitudes; many, however, were equal to stars of the 1st magnitude, and several of the finest exceeded the planets Jupiter and Venus when in their positions of maximum brilliancy. The colour for the most part was white; in many, however, it was yellow or orange, and in several of the brightest it was at first white and then a deep red immediately before extinction.

Most of the brighter meteors left luminous trains, but these seldom remained visible for more than a few seconds.

The apparent velocity of movement was decidedly less than that of the 13th of November meteors.

The paths of many of the meteors were more or less curved, and many of them formed curves of double curvature.

It was observed that the radiant point appeared to move to the eastward during the progress of the shower, so that the mean position, from the observations made up to 8h. 34m., was about 3 degrees to the west of the position derived from the observations made afterwards.

The mean position of the radiant point, as given above, shows that the course of the stream coincides almost exactly with the orbit of Biela's comet.

3. By Alfred Brothers, F.R.A.S.—The sky at Wilmslow appears to have been less clouded than at Cheetham Hill, and I may therefore have had a better view of the display than Mr. Baxendell. From about 5.50 to 8.30 there was very little cloud, and during that the meteors were falling very nearly at the same rate. There was no difficulty in determining the radiant point—γ Andromedæ being about the centre.

Probably few meteor showers have ever been seen more favourably for determining their radiancy than this one. The result of careful counting by myself and Mr. Wilde was that from 1800 to 2000 per hour were visible to the naked eye. The N.W. horizon was distinctly illuminated about 8 o'clock by auroral light, and the whole sky was more or less luminous during the whole time.

Mr. W. Boyd Dawkins, F.R.S., brought before the notice of the Society some remarkable forms of stalagmites which he had obtained from some caves near Tenby. In one cave the calcareous deposit had taken the form of small mushrooms standing close together with a stem not much thicker than a hair, that covered every part of the surface, and in some places had their tops of a dull red colour, and in others of a snow white. In a second every pool was lined with most beautiful crystals of a dog-tooth spar, while from the roof there descended slender stalactitic pillars, some snow white and others of a deep red, and most of the thickness of a straw. They stood almost as closely together as the stems of wheat in a wheat-field. In a few pools where the drip caused constant agitation of the water, pea-like rounded concretions of carbonate of lime were formed, some of which, polished by friction, were almost as lustrous as pearls, and might fairly be termed "cave-pearls."

"*On the date of the Conquest of South Lancashire by the English*," by W. Boyd Dawkins, M.A., F.R.S.

"*On some Human Bones found at Buttington, Montgomeryshire*," by W. Boyd Dawkins, F.R.S.

"*On the Connexion between Clouds and the Phenomena of Thunder Storms*," by Professor Osborne Reynolds, M.A.

The object of this paper is to point out the three following propositions respecting the behaviour of clouds under conditions of electrical induction, and to suggest an explanation of thunder storms based on these propositions and on the assumption that the *sun is in the condition of a body charged with negative electricity*: an assumption which I have already made in order to explain the Solar Corona, Comets' Tails, and Terrestrial Magnetism.

1. A cloud floating in *dry* air forms an insulated electrical conductor.

2. When such a cloud is *first* formed it will not be charged with electricity, but will be ready to receive a charge from any excited body to which it is near enough.

3. When a cloud charged with electricity is *diminished* by evaporation, the tension of its charge will increase until it finds relief.

I do not imagine that the truth of these propositions will be questioned, but rather that they will be treated as self evident. However, as a matter of interest, I have made some experiments to prove their truth, in which I have been more or less successful.

Experiment 1 was to show that a cloud in dry air acts

the part of an insulated conductor. The steam from a vessel of hot water was allowed to rise past a conductor, the apparatus being in front of a large fire, so that the air was very dry. When the conductor was charged the column of vapour was deflected from the vertical to the conductor both for a positive and negative charge.

Experiment 2 was made with the same object as Experiment 1. A gold leaf electrometer was charged so that the leaves stood open and then a cloud made to pass by the insulated leaves. As the cloud passed they were both attracted. This experiment was attended with considerable difficulty, as the moisture from the steam seemed to get on to the glass shade over the gold leaves and so form a charged conductor between the leaves and cloud. The cloud was first formed by a jet of steam from a a pipe, then by the vapour from a vessel of boiling water, and lastly, by a smoke ring or rather a steam ring. By this latter method an *insulated* cloud was formed, which, as it passed, was attracted by the charged leaf.

Of the two latter propositions I have not been able to obtain any experimental proof. I made an attempt, but failed, through the bursting of the vessel in which the cloud was to be formed. I hope, however, shortly to be able to renew the attempt, and in the meantime I will take it for granted that these propositions are true. Faraday maintained that evaporation was not attended by electrical separation unless the vapour was driven against some solid, when the friction of the particles of water gave rise to electricity. So that unless there were some free electricity in the steam or vapour before it was condensed none could be produced by the condensation, and hence the cloud when formed would be uncharged.

In the same way with regard to evaporation, unless, as is very improbable, the steam into which the water is turned retains the electricity which was previously In the condensed vapour; the electricity from that part of the cloud which evaporates must be left to increase the tension of the remainder. So that, as a charged cloud is diminished by evaporation, the tension of the charge will increase, although the charge remains the same.

I will now point out what I think to be the bearing which these propositions have on the explanation of thunder storms. In doing this, I am met with a great difficulty, namely, ignorance of what actually goes on in a thunder storm. We seem to have no knowledge of any laws relating to these every-day phenomena; in fact we are where Franklin left us—we know that lightning is electricity and that is all.

It is not, I think, decided whether the storm is incidental on the electrical disturbance or *vice versa*, *i.e.*, whether the electricity causes the clouds and storm or is a mere attendant on them. Nor can I ascertain that there is any certain information as to whether, when the discharge is between the earth and the clouds, the clouds are positive and the earth negative, or *vice versa*. Such information as I can get appears to point out the following law: that in the case of a fresh-formed storm, the cloud is negative and the earth positive; whereas, in other cases, the cloud is positive and the earth negative.

Again, thunder storms move without wind or independently of wind; but I am not aware whether any law connecting this motion with the time of day, &c., has ever been observed, though it seems natural that, however complicated by wind and other circumstance, some such law must exist. In this state of ignorance of what the phenomena of thunder really are, it is no good attempting to explain them. What I shall do, therefore, is to show how the inductive action of the *Sun* would necessarily cause certain clouds to be thunder clouds in a manner closely resembling, and for all we know identical with, actual thunder storms.

In doing this I assume that the thunder is only an attendant on the storm and not the cause of it; and that many of the phenomena, such as forked and sheet lightning, are the result of different states of dampness of the air and different densities in the clouds, and really indicate nothing as to the cause of electricity. In the same way, the periodicity of the storms is referred to the periodical recurrence of certain states of dryness in the atmosphere. Thus the fact that there is no thunder in winter is assumed to be owing to the dampness of the air, which allows the electricity to pass from and to the clouds quietly. What I wish to do is to explain the cause of a cloud being at certain times in a different state of electric excitation to the earth and other clouds, and of this difference being sometimes on the positive side and sometimes on the negative, that is to say, why a cloud should sometimes appear to us on the earth to be positively charged, sometimes negatively, and at others not to be charged at all.

The assumed condition of the sun and earth may be represented by two conductors S and E, acting on one another by induction, the sun being negative and the earth positive. The distance between these bodies is so great that the inductive action would not be confined to those parts which are opposed, but would in a greater or less degree extend all over their surfaces, though it would still be greater on that side of E which is opposite to S than on the other side.

The conductor E must be surrounded by an imperfectly insulating medium to represent damp air. The formation of a cloud may then be represented by the introduction of a conductor C near to the surface of E. Such a conductor at first having no charge would attract the positive electricity in E and appear by reference to E to be negatively charged. If it was near enough to E, a spark would at once pass, which would represent a flash of forked lightning. If it were not near enough for this it would obtain a charge through the imperfect insulation of the medium. Such a charge might pass quietly or by the electric brush. When the cloud had obtained a a charge it would not exert any influence on the earth, unless it altered its position. But if the heat of the sun caused part of the cloud to evaporate the remainder would be surcharged and appear positive. Or if C approached E then C would be overcharged, and a part of its electricity would return, and on its return it might cause positive lightning. Thus, suppose that after a cloud had obtained its charge part of it came down suddenly in the form of rain. As the rain came lower its electric tension would increase until it got near enough the ground to relieve itself with a flash of lightning, almost immediately after which the first rain would reach the ground. It has often been noticed that something like this often takes place; it often begins to pour immediately after a flash of lightning, so much so that it seems that the electricity had been holding the rain up, and it was only after the discharge that it could fall. This, however, cannot be the case, for the rain often follows so quickly after the flash that there would not have been time for it to fall from the cloud unless it had started before the discharge took place. If, on the other hand, C receded from E, it would again be in a position to accept more electricity, or would again become negative. In this way, a cloud in forming, or when first formed, would appear negatively charged; soon after it would become neutral, and then if it moved to or from the earth it would appear positively or negatively charged.

If the air was very dry, as it is in the summer, any exchange of electricity between the earth and the cloud would cause forked lightning, in the winter it would take place quietly, by the conduction of the moist atmosphere.

In this way then there would sometimes be positive, sometimes negative lightning; sometimes the discharge would be a forked flash or spark, sometimes a brush or sheet lightning. And if clouds are formed in several layers, as would be represented by another conductor, D, outside C, then, in addition to the phenomena already mentioned, similar phenomena would take place between C and D; and if, in addition to this, we were to assume

that there are other clouds in the neighbourhood, the phenomena might be complicated to any extent.

And if, further, the motion of the sun is taken into account; as the conductor S moves round E the charges in D and E would vary, accordingly as they were more or less between S and E and directly under the induction of S; *i.e.*, the charge in a cloud would appear to change owing to the motion of the sun; thus, a cloud that appeared neutral at mid-day would, if it did not receive or give off any electricity, become charged positively in the evening.

With regard to the independent motion of the clouds, there are several causes which would effect it. For instance, a cloud whether it appeared on the earth to be negatively or positively charged, would always tend to follow the sun, though it is possible this tendency might be very slight. Again, one cloud would attract or repel another, according as they were charged with the opposite or the same electricities; and in the same way a cloud would be attracted or repelled by a hill, according to the nature of their respectfve charges.

Such, then, would be some of the more apparent phenomena under the assumed conditions. So far as I can see, they agree well with the general appearance of what actually takes place, but, as I have previously said, the laws relating to thunder storms are not sufficiently known to warrant me in doing more than suggesting this as a probable explanation.

In these remarks I have said nothing whatever about what is called atmospheric electricity, or the apparent increase of positive tension as we proceed away from the surface of the earth. I do not think that this has much to do with thunder storms. If the law is established, it seems to me that it will require some explanation, besides merely that of the solar induction acting through the earth's atmosphere on to the surface of the earth. It would rather imply that the sun acts on some electricity in the higher regions of the earth's atmosphere, and that electricity in these regions acts again on the surface of the earth; but, however this may be, the effect of the assumptions described in this paper would be much the same.

NOTICES OF BOOKS.

Introduction to Inorganic Chemistry. By William George Valentin, F.C.S., Principal Demonstrator of Practical Chemistry in the Royal School of Mines and Science Training Schools, South Kensington.

The student of chemistry must be sometimes at a loss to distinguish for himself the best text-book. Each of the numerous volumes from which he may select has its peculiar feature; and the existence of this plurity of teaching-methods is suggestive of the fecundity of the science, But many text-books unhappily differ in little more than the authors' names; in them there is given description of the orthodox method of preparing hydrogen from water, sulphuric acid, and zinc, as well as orthodox methods of obtaining other elements; some books vary the process by recommending expensive apparatus, others go to the opposite extreme of imagining all students trained mechanicians or artizans. Few of the text-books detail fully the method of preparing, say hydrogen, from the action of sodium upon water, the decomposition of water by electrolysis, by heated oxidisable bodies, &c.; but among the number who are content to treat chemistry as an experimental science, Mr. Valentin ranks in the first order. His book records the neatest modes of preparing an experiment, and the bearing of the experiment upon the general theory of chemical science. As a practical handbook the student need go in search no farther, for while he is acquiring the facts here given he will be laying the foundation of a truly scientific education.

CORRESPONDENCE.

CHEMISTRY OF ACID MANUFACTURE.

To the Editor of the Chemical News.

Sir,—In your report of the transactions of the Manchester Literary and Phllosophical Society, page 307 of your last issue, you give an abstract of a paper "On some points in the Chemistry of Acid Manufacture," by H. A. Smith, F.C.S.

Is it in your power to give the whole of the paper? for as the report at present stands, I venture to think it is of but little service, no experimental data being given—no descriptions of the modes of experimenting. Indeed, it is temptingly provocative of adverse criticism, which further explanation might remove, and so convert the paper into a really valuable contribution on a most interesting subject.—I am, &c.,

Charles F. Burnard.

Dec. 28, 1872.

ANALYSIS OF MANURES.

To the Editor of the Chemical News.

Sir,—Having just seen Mr. Reynolds's proposition for a more correct scale of valuation for the constituents in artificial manures, I would like to draw his attention, as a primary question, to the means of ascertaining the relative proportions of the ingredients he names in manures. As yet it seems beyond the means of ordinary analyses. Mr. Reynolds admits a difference in the value of mineral and bone phosphates. If, then, a farmer buys a quantity of manure under the common name of "Dissolved bones"—if he sends a sample of this to a chemist, and requests to know whether all the phosphates present are bone, and if not, how much of them are from minerals, can the chemist tell this? We suspect not. We have heard chemists of very high standing confess that when dissolved they cannot tell, and even the portion not in a soluble condition, if equal ground, the proportions of the one and the other cannot be given. This is what farmers wish to know, and then the true value is of easy determination; and so long as bones are nearly double the price of mineral, and no positive means of determining when and to what extent they are mixed, the farmer will be at the mercy of the adulterator. The relative quantity of ammonia as such in a manure and ammonia latent is within ordinary analysis, and ought to be determined and relatively valued—a matter long overlooked. I would suggest that Mr. Reynolds turn his attention to the determining the relative quantities of bone and mineral phosphates when they are mixed in a manure.—I am, &c.,

J. Napier.

Glasgow, 25th Dec., 1872.

MISCELLANEOUS.

The Royal Polytechnic.—Never was a more attractive or more varied programme issued from this institution than that provided for the Christmas holidays. It includes a lecture by Professor E. V. Gardner, F.E.S., M.S.A., on the History of a Plum Pudding, an amusing entertainment by Mr. George Buckland, and a ghost illusion entitled "The White Lady of Avenel," the incidents of

which are taken from Sir Walter Scott's tale of the "Monastery." It has been skilfully arranged by one of the Directors, Dr. Croft, who takes a lively interest in, and devotes much time to, the interests of the Polytechnic.

London International Exhibition, 1873.—The second meeting of the Committee on Surgical Instruments and Appliances was held on the 23rd December, 1872, at 3 o'clock, in the offices, Gore Lodge, South Kensington. Among those present were Mr. Cæsar H. Hawkins, F.R.S., in the chair, Sir William Fergusson, Bart., F.R.S., Dr. P. Allen, Mr. W. Bowman, F.R.S., Mr. B. Brudenell Carter, Mr. W. White Cooper, Dr. W. T. Domville, R.N., Dr. Arthur Farre, F.R.S., Dr. G. T. Gream, Mr. Prescott G. Hewett, Mr. J. Hilton, F.R.S., Mr. J. Hinton, Professor J. Marshall, F.R.S., Mr. T. W. Nunn, Dr. W. S. Playfair, Mr. R. Quain, F.R.S., and Mr. Edwin Saunders. Letters received from the Royal College of Surgeons, and the Royal Medico-Chirurgical Society were read, and it was stated that many of the leading surgical instrument makers in London, Dublin, Paris, and other capitals had signified their intention to contribute. It was suggested that the Exhibition should be brought before the notice of the British Medical Association at its meeting in August, 1873. The committee resolved to recommend the Royal Commissioners to invite corresponding members in foreign countries, and after the transaction of general business adjourned till Monday, the 20th January, 1873.

MEETINGS FOR THE WEEK.

MONDAY, Jan. 6th.—Medical, 8.
TUESDAY, 7th.—Royal Institution, 3. Juvenile Lectures.
—— Anthropological, 8
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WEDNESDAY, 8th.—Geological, 8
THURSDAY, 9th.—Royal Institution, 3.
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THE CHEMICAL NEWS.

VOL. XXVII. No. 685.

ON A SOURCE OF ERROR IN THE VALUATION OF PYRITES.*

By NICHOLAS GLENDINNING and ALFRED J. M. EDGER.

THE great consumption of pyrites in industrial chemistry renders the accurate determination of the sulphur it contains a matter of great commercial importance. Judging however, from the serious discrepancies which so frequently occur in the results obtained by different chemists when operating upon the same sample, it would appear that the estimation of sulphur is either surrounded by great difficulty or performed under very defective manipulation.

It will be quite within the recollection of the members of this society that their attention was drawn by a late president (Mr. Glover) to the differences observable in the results obtained by different experimenters. This gentleman explained that in seven samples, each tested by two professional chemists, there was a maximum difference of 1·9, a minimum of 1·4, and an average of 1·6 per cent of sulphur, but differences still greater have come under our own observation. This subject was afterwards noticed by Messrs. Teschemacher and Smith in their article "On the Estimation of Sulphur by Barium," published in the CHEMICAL NEWS, vol. xxiv., p. 61. They were of opinion that the observed differences might be traceable to different methods of testing, and adduced a number of results by way of proof that the method then in general use was not reliable.

Shortly after the appearance of their article we published results in support of that method (see CHEMICAL NEWS, vol. xxiv., p. 140), and we now beg to draw your attention to a source of error which precedes the analytical process, and precludes the possibility of correct results being obtained,. We allude to the use of the wedgwood mortar in the preparation of the portion for analysis, and are persuaded that its use obtains very generally in both professional and private laboratories.

In the midst of all the contention respecting the differences between results, it does not seem to have occurred to the experimenters that the cause of difference might be introduced in the preparation of the sample ; and yet it must have been observed that, to whatever use a wedgwood mortar has been applied, a very perceptible wearing is effected in course of time. A few years ago we devoted some attention to the differences which were causing so much annoyance ; and from the circumstance of mortars becoming somewhat worn, we inferred that this might be the solution of the problem, and subsequent experiments proved the accuracy of this conclusion.

We prepared a sample by passing it through a sieve of 529 meshes to the inch to ensure uniformity of composition, and then reduced portions to an impalpable powder for analysis ; and then estimated in the several portions the sulphur and sand. The sulphur results were found to differ to an extent in some cases of upwards of 2 per cent, and this was accounted for by the amount of sand found in their respective portions. We at once saw that the wedgwood mortar was quite unsuited to the purpose, and have since prepared samples in a different way. We will now proceed to lay before you some results obtained quite recently from samples prepared in various ways.

1. A sample of pyrites was passed through a sieve of the above description, the coarser particles being reduced in a hard wedgwood mortar, and after thorough mixing a quantity was reduced to an impalpable powder in the same mortar. Two determinations of the sulphur and sand in the portion gave the following results :—Sulphur, 45·08 per cent ; sand, 8·92 per cent ; and sulphur, 45·04 per cent ; sand, 8·88 per cent.

2. Another portion of the sifted sample was similarly reduced in a wedgwood mortar, which had been in use for some considerable time previously (this mortar was perceptibly softer than that used in the preceding experiment). Two determinations of sulphur and sand gave—Sulphur, 43·56 per cent ; sand, 11·52 per cent ; and sulphur, 43·44 per cent ; sand, 11·50 per cent.

3. Another portion of the same sifted sample, reduced in an agate mortar, gave in two determinations :—Sulphur, 46·28 per cent ; sand, 6·2 per cent ; and sulphur, 46·15 per cent ; sand, 6·24 per cent.

4. A duplicate sample of the same ore, instead of being ground in a wedgwood was reduced in a steel mortar, and a portion brought to an impalpable powder in the agate, two determinations giving :—Sulphur, 46·25 per cent ; sand, 6·11 per cent ; and sulphur, 46·36 per cent ; sand, 6·13 per cent. The following is an arrangement of the results in a tabular form :—

Sulphur per cent.	Sand per cent.	Average Sulphur per cent.	Average Sand per cent.
1. Wedgwood mortar alone—			
45·08	8·92	45·06	8·90
45·04	8·88		
2. Wedgwood mortar alone—			
43·56	11·52	43·50	11·51
43·44	11·50		
3. Wedgwood and agate mortars—			
46·28	6·20	46·21	6·22
46·15	6·24		
4. Steel and agate mortars—			
46·25	6·11	46·30	6·12
46·36	6·13		

It will be observed that the difference between the results of Nos. 4 and 2 is, sulphur 2·80, and sand 5·39 per cent ; and between Nos. 4 and 1, sulphur 1·24, and sand 2·78 per cent ; whilst between Nos. 4 and 3 there is only the slight difference of sulphur 0·09, and sand 0·10 per cent.

Duplicate samples of another pyrites were tested by a metropolitan professional chemist, a local professional chemist, and ourselves, with the following results :—

	A.	B.	C.	
Sulphur per cent	43·8	45·5	46·84	46·8
Sand per cent	8·3	8·1	5·60	5·5

We may mention that A represents the results of the metropolitan chemist, and B those of the local chemist.

Our sulphur results were obtained by the method described in our article in the CHEMICAL NEWS before alluded to, which we can, with great confidence, recommend as capable of giving concordant and reliable results.

We may remark that the sulphur result of No. 2 is not sufficiently high by 0·3 per cent if the difference between its sand and that of No. 4 be taken as the full extent of the contamination. We have, however, so repeatedly found this to occur that we assume that some portion of the detached mortar is soluble in the acids employed—probably not the wedgwood itself, but matter which the mortar may have absorbed during its use, It is obvious from these results that by using the wedgwood mortar very serious differences may arise, their extent varying of course with circumstances, *e.g.*, the hardness of the sample, the hardness of the mortar and its condition, and the industry of the operator.

In conclusion, we hope we are justified in assuming that the results we have had the pleasure of laying before you afford sufficient proof that the use of the wedgwood mortar involves a more or less serious depreciation of the

* Read before the Newcastle-on-Tyne Chemical Society, Dec. 19, 1872.

sample, and that under these circumstances the probability of the attainment of a result representing the true value of the sample as it reached the assayer's laboratory is of a most remote character, and an occurrence which can only be due to an error in analysis.

Note. Since reading the above paper, we have made experiments substituting the porcelain in lieu of the weedgwood mortar in the preparation of the test sample, and the results obtained show that it also contaminates the sample to a serious extent, as will be seen from the following results:—A sample of the same pyrites as was used in the preceding experiments (and which gave by the steel and agate mortars in two determinations—Sulphur, 46·25 per cent; sand, 6·11 per cent; and sulphur, 46·36 per cent; sand, 6·13 per cent) gave when the porcelain mortar was used—Sulphur, 45·3 per cent: sand, 8·21 per cent; and sulphur, 45·36 per cent; sand, 8·23 per cent. Or, comparing their averages, the results of the porcelain mortar show an excess of 2·1 per cent of siliceous matter, and a deficiency of 0·97 per cent of sulphur.

ON THE

ESTIMATION OF MANGANESE IN PIG-IRON, STEEL, AND WROUGHT-IRON.

By F. KESSLER.

As, in these days, iron which contains more or less manganese is considered to be more or less valuable, it occurred to me to try to devise a method whereby the estimation of manganese in the above-named materials might be rendered more expeditious and less liable to the errors ordinarily inherent in that estimation. At a future period I intend to publish an exhaustive account of my researches; I therefore now communicate only what is of direct practical utility.

When a hydrochloric acid solution of perchloride of iron is neutralised by means of carbonate of soda, so as to cause a permanent precipitate, and the latter is cautiously re-dissolved by the addition of some hydrochloric acid, a liquid is obtained which contains fourteen times its equivalent of ferric hydrate in solution, yet it is not precipitated by boiling. In order, therefore, to precipitate the iron by means of acetate of soda, aided by boiling heat, there is, theoretically, only as much acetate required as is sufficient to convert the chloride into acetate, viz., 3 molecules of acetate to 15 atoms of iron, or 1 part, by weight, of crystallised acetate of soda to 2 parts, by weight, of iron. It is, indeed, an easy matter to precipitate completely, by boiling, from previously carefully neutralised iron solutions, 1·1 grm. of iron upon 500 c.c. of fluid by means of 1 grm. of acetate of soda, even when, in order to prevent the possible decomposition of other acetates, 1 grm. of acetic acid had been added. Under these conditions, only very small portions of manganese are thrown down along with the iron—for instance, from 13 per cent only about 0·02 to 0·05 per cent, and less when the quantity of manganese is smaller.

From what has just been stated, it is quite evident that the loss often experienced in the estimation of manganese by the method just alluded to is mainly due to the fact that too large a quantity of acetate of soda is employed, in consequence of which a portion of the chloride of manganese is also converted into acetate, which salt is readily decomposed into protoxide and acid, a fact almost entirely overlooked. It is probable that my improved method may also be applied to the separation of iron from zinc, copper, nickel, and cobalt. Before I found out this method I used sulphate of soda, for decomposing the previously neutralised chloride of iron. Although this salt may even be used in excess without any manganese being precipitated, I found that 1 grm. of it is sufficient to separate 1·1 grm. of iron; only a very small quantity of it remains in solution, and this quantity does not vitiate the results. In order to obviate the washing of the precipitate, I dilute the previously-cooled fluid to 500 c.c. I next filter it through a dry filter, and take 250 c.c. of the filtrate, equal to 0·55 grm. of the quantity of the material originally taken, and in these 250 c.c. I estimate the manganese. When the manganese is intended to be precipitated by a further addition of acetate and bromine, and the quantity of dioxide of manganese then acidimetrically determined, we again meet with the difficulties occasioned by the ready decomposition of the acetate of manganese, and the capability of the dioxide of entering into combination with the lower oxides of manganese, and consequently the protoxide. These difficulties are best met by the following method of operation:—10 grms. of sodic acetate are dissolved in 150 c.c. of water, 50 c.c. of bromine-water are added, and, at intervals of half an hour, 50 c.c. of the manganese solution, care being taken that at the third half-hour 50 c.c. of bromine-water be again added to the fluid, to which heat should not be applied.

In this manner, the manganese dioxide is thrown down from so dilute a solution that only from 0·02 to 0·03 per cent of manganese out of 13 per cent are lost in the shape of protoxide. On the other hand, small, but, with the whole quantity, proportional, quantities of manganese remain, either in solution as permanganate, or are so fixed to the sides of the glass vessel in which the operation takes place, that it is necessary to re-dissolve it. After the free bromine has been driven off by heat, the precipitate is filtered off, washed with dilute solution of acetate of soda, and then treated, together with the filter, with from 5 to 15 c.c. of a solution of chloride of antimony (1 to 5) and 15 c.c. of concentrated hydrochloric acid, after which the fluid is diluted with 100 c.c. and titrated with decimal permanganate solution, 1 c.c. of which then equals 0·5 per cent of manganese. When the quantity of manganese is less (below 1 per cent), all quantities are tripled, and 5-6ths of the filtrate from the iron precipitate, previously concentrated by evaporation, are treated for manganese, 1 c.c. of permanganate becoming in this case equal to 0·1 per cent of Mn.

The titre of the solution of permanganate is found, either by comparing it with a solution of potassic bichromate of known strength by means of chloride of antimony, or by investigating a known quantity of pure protoxide of manganese according to the method described above. By mixing pure solutions of manganese (I often used for this purpose solutions of permanganate of known strength, with solutions of iron, the manganese in which had been previously determined, in variable proportions), I made mixtures for testing, in which the quantity of manganese varied from 0·1 to 13 per cent. As instances of at least four experiments, I quote the following:—

	Per cent Mn.						
Used..	0·118	0·218	0·568	1·051	3·050	7·048	13·045
Found	0·116	0·216	0·548	1·053	3·028	7·006	12·982
Difference	0·002	−0·002	−0·020	+0·002	−0·022	−0·042	−0·063

In order to elucidate the action of the sources of error, I precipitated, in direct contravention to the precept above quoted, the ferric hydrate by means of 15 grms. of acetate of soda, without adding free acetic acid, from 300 c.c. of fluid, and the loss of manganese for the undermentioned quantities was as follows:—

	Per cent Mn.			
	1·00	3·00	7·00	13·00
Loss	0·21	0·60	0·87	1·06

The loss was analogous, although less marked, when, deviating from the normal method, the manganese was thrown down at once in the total 210 c.c. of fluid by means of 15 grms. and 30 grms. of acetate respectively; for, by a quantity of 13 per cent of manganese as maximum, the loss amounted to 0·13 and 0·25 per cent respectively. I have further found that, as regards copper, nickel,

and cobalt, metals often present in iron in greater or less quantity, small quantities are thrown down along with the manganese precipitate, copper and nickel only as monoxides, but cobalt as sesquioxide; the latter, therefore, unless it be separately estimated, may bring on a slight error, so that the quantity of manganese would be found somewhat too large, viz., about half the quantity of the cobalt present.—*Ber. d. Deutsch. Chem. Gesells.*

THE ESTIMATION OF SULPHUR IN PYRITES.

By PHILIP HOLLAND.

THE practical importance of providing a reliable method for estimating sulphur in pyrites has, I need hardly say, been fully realised by chemists who are called upon to make assays of this kind.

The experiments detailed in the present communication, some of which have yielded but indifferent results, were made, not so much with a view of arriving at an entirely new scheme for valuing sulphur ores, but rather to supplement our present ways and means of conducting the operations now in vogue. For most purposes, I think it may be assumed that sulphur in mineral substances is usually, if not invariably, determined as sulphate of barium, and that there are four methods in general use for this purpose—three direct, and one somewhat indirect. The direct comprise a gravimetric and two volumetric processes. The indirect is also a volumetric one, and is known as Mohr's alkalimetric method, useful in many cases, but scarcely applicable to the valuation of pyrites, since the conditions of an assay are not usually such as readily to adapt themselves to it. I tried the following alkalimetric process, which I believe has been already described by Bohlig (*Fresenius's Zeitschrift*) for estimating sulphuric acid, with the intention of applying it to the valuation of pyrites. It was soon evident, however, that the experimental conditions of an assay are not such as to adapt themselves readily to it.

If hydrate of barium be added to a neutral solution of a sulphate of an alkali, and the excess be removed by CO_2, the amount of caustic alkali liberated will be equivalent to the sulphuric acid previously combined in the absence of phosphates and fluorides. The solution containing the soluble sulphate in the presence of free HCl is precisely neutralised whilst boiling with sodium carbonate free from sulphuric acid. Hydrate of barium is then added in slight excess, the whole boiled for a few minutes, and the excess removed by CO_2. After filtration and thorough washing of the residue on the filter by boiling-water, the filtrate is neutralised by standard acid. The following experiments were made; the volume of fluid was in each about 250 c.c.:—

Amount of Standard Sulphuric Acid taken.	Amount of SO_3 in grammes.	Amount of SO_3 found.	Per cent of SO_3.
c.c.			
2	0·08	0·080	4·00
4	0·16	0·158	3·95
6	0·24	0·220	3·66
8	0·32	0·300	3·75
10	0·40	0·368	3·68
12	0·48	0·460	3·83
14	0·56	0·515	3·67
16	0·64	0·600	3·75
18	0·72	0·688	3·82
20	0·80	0·762	3·81
30	1·20	1·100	3·66

I may remark that the burette used to measure the standard acid at the commencement of the experiment was the one which measured the same acid when titrating the alkali, consequently the amount of acid used in the latter part of the process should have precisely equalled that in the first stage had there not been a loss of alkali. Some of the experiments were repeated, and similar results were obtained; the error was always one of deficiency when the sulphuric acid was about half a gramme. The low results are doubtless due to the fact that boiling water fails to remove all alkali from the mixed precipitates, which is not at variance with our present knowledge of the properties of barium precipitates generally. I did not continue this enquiry further, inasmuch as it did not seem probable that closer numbers would be obtained unless the process was inconveniently prolonged.

The next method to which some attention was paid is the direct volumetric one of Wildenstein, which has lately been carefully studied by Messrs. Teschemacher and Denham Smith; I am able to confirm much that these chemists have said about it in several particulars. My own experiments satisfy me that it is desirable to conduct the titration in the presence of but little free HCl, in the entire absence of nitric acid, and to standardise the barium chloride by iron sulphate, as nearly as possible under the conditions which will prevail in a pyrites assay so far as the amount of free acid and volume of fluid are concerned. Some little difficulty is experienced in deciding what shall be considered the end-point of the titration, owing to the so-called neutral point in the fluid when a drop of either barium chloride or sulphuric acid produces a slight turbidity.

I may just mention that up to a certain stage the testing for excess of barium can be done on a watch-glass. A drop of the partially clear solution is removed by means of a narrow tube pipette. A drop of the barium solution from the burette is brought near, and the two fluids allowed to run together. If the point of contact be carefully observed, the appearance of a faint opalescence will indicate sulphuric acid. The rapidity of the change and the depth of the opalescence serve to warn the operator of the approaching completion of his experiment. The absolute completion cannot be decided except on a filtered portion in a tube, and this can only be done under certain conditions, as the following observation testifies. Two measured equal volumes (4 c.c.) of the solution in a pyrites assay were taken, and to each was added respectively and at the same time one drop less than 0·1 of a c.c. of the normal barium, and a like amount of normal sulphuric acid. In the tube to which the acid was added a slight turbidity appeared at the end of a minute and a half; in the other tube the fluid remained quite clear. To the latter four additional drops of barium were added, when a turbidity showed itself in a few seconds. I am not able to give an explanation of the phenomenon. Perhaps sulphate of barium is slightly soluble in a solution not containing too large an excess of $BaCl_2$? Whatever may be the explanation, the reaction must be taken into account when verifying the strength of the barium chloride.

In assaying pyrites for sulphur only by the fusion method, I have worked as follows and obtained good results. The process will no doubt be useful in laboratories which do not possess large platinum crucibles. A test-tube or piece of sealed combustion-tube, about six inches long and half an inch internal width, is fitted with a cork and delivery tube, the latter bent at a right angle and long enough to reach to the bottom of the flask in which it is intended to make the titration. The fusion mixture consists of equal parts of nitre and ignited acid carbonate of sodium, both free from sulphur, dry, and in fine powder. Nine to ten grammes is taken in an operation, together with one of pyrites, the latter must be in exceedingly fine powder; the two are mixed in a warm porcelain dish or agate mortar, and transferred to the tube without loss. The delivery tube is then inserted with its extremity dipping into the flask. A channel is made on the surface of the mixture, and the tube suitably supported is heated in small portions at a time with a Bunsen gas flame, commencing as usual with the anterior portion. When the operation is progressing favourably, the deflagration proceeds for a few seconds after removing the flam

There is no danger to be apprehended, and the tube does not crack or blow out with proper care. When the tube has been heated throughout, and the deflagration has ceased, it is then more strongly heated with a Herapath or powerful gas flame. It is a good plan at this stage to slip a coil of wire gauze over the tube, which helps to accumulate the heat. It is not, however, necessary that the contents should be fused a second time, at least this has not been done in experiments appended. The sulphur ores examined have yielded their sulphur readily.

The gaseous products of the combustion which mechanically carry over with them small quantities of sulphates or sulphuric acid, being heavier than air, collect in the flask, and are washed by shaking with a little water, closing the flask with the palm of the hand. The delivery tube is also washed. That containing the fused mass is carefully broken and put in the flask, together with sufficient hydrochloric acid to dissolve nearly the whole of the iron oxide; then ammonia is added, until a precipitate of oxide reappears, and lastly as much free HCl and water as are necessary to bring the fluid to the conditions which obtained when the barium solution was standardised. I have used 2 c.c. of free acid, and the total volume of solution was 200 c.c.

Experiments have been made on three samples of iron pyrites. The one containing the most sulphur has a bright crystalline fracture, and appears to contain but little siliceous matter. I have not made a complete analysis of it, as I wish to reserve a specimen. It was given to me by the landlord of a small inn at Macugnaga in the Val-Anzasca, near which place a mining company has been established to work the vein. The mineral is said to contain gold.

I am uncertain of the source of the other two specimens. In the following experiments I have compared the results obtained by the method of working just described with those obtained by oxidising the sulphide with nitro-hydrochloric acid.

In some laboratories both processes are used in valuing sulphur ores. The tables give the sulphur per cent on the dry sample.

(1) Val-Anzasca.		(2)		(3)	
By oxidation with acid.	By fusion.	By oxidation with acid.	By fusion.	By oxidation with acid.	Fusion.
50·39	50·52	47·46	47·33	45·85	45·85
50·44	50·44	47·38	47·46	45·81	45·75
50·52	50·37	47·44	47·54	45·77	45·84
50·50	50·38	47·38	47·49	45·69	45·79
50·39	50·52	47·33	47·46	45·84	45·83
50·52	50·52	47·54	47·38	45·85	45·76
Mean 50·46	50·45	47·42	47·44	45·80	45·80

A single gravimetric determination was made on the Val-Anzasca specimen; the number obtained was 50·44. Nitro-hydrochloric acid was used to oxidise the sulphur, and the excess was removed by evaporation at 100° C. before adding the barium salt; the precipitation was made in the boiling solution, which was somewhat dilute.

The chief cause of failure in conducting a fusion as above described is the possible incomplete oxidation of the sulphur. Such is rarely the case, provided the heat is sufficient and the mineral finely divided. To insure the latter condition it is desirable to sift the dry sample through muslin.

I have not had an opportunity of extending the method to sulphur minerals generally, but there is little doubt that most, if not all, can be decomposed in this manner without loss of sulphur—that is to say, if ordinary precaution be taken. An anterior layer of fusion mixture may be dispensed with, and it is not necessary to rinse the dish; a camel-hair brush will remove any remaining particles both from it and the mouth of the tube.

DETECTION AND ESTIMATION OF PARAFFINE IN STEARINE CANDLES.

By M. HOCK.

MAKERS of stearine candles mix paraffine with the fatty mass in quantities up to 20 per cent. Paraffine candle makers also mix stearic acid with their paraffine, and attribute valuable properties to such a mixture, so far as candle-making is concerned. The attempt to determine if paraffine be present, and if so, to get some approximate idea of the quantity, in a sample of stearine and *vice versa*, by means of the comparison of the melting-point and specific gravity of such a mixture, is shown to be useless, as these vary according to the source from which the paraffine is obtained, as also in the case of the stearic acid, since the pure commercial article is by no means a chemically pure article.

A good method for detecting the presence of stearic acid in paraffine has been devised by R. Wagner, viz., by treating a boiling solution of the paraffine in alcohol with an alcoholic solution of neutral acetate of lead, when, if stearic acid be present, a dense floccular precipitate appears, but none if it be absent. The best method, and one which can be used quantitatively as well as qualitatively, is described as follows:—

Not less than 5 grms. of the candle are taken and treated with warm solution of hydrate of potash, which must not be too concentrated. A soap is formed with the stearic acid, whilst the paraffine is left unaltered. Salt is thrown into the solution, whereby the soap is separated out as a soda soap, and in precipitating takes down the paraffine with it. The soap obtained is thrown on the filter and washed with cold water or very dilute spirits of wine. Thus, firstly, the salt is washed out, and finally, the soap is brought into solution and likewise washed through the filter, leaving the paraffine, which is then dried at a temperature below 35° C., so as not to fuse it. The paraffine is then treated on the filter with ether, and after repeated washing with this solvent, the ethereal solution is carefully evaporated in a weighed porcelain crucible, in the water-bath, at a low temperature. The residue, consisting of the paraffine, is then weighed, and the stearic acid is estimated by difference.

ON THE MEANS OF REGULATING GAS-FLAMES SO AS TO OBTAIN A CONSTANT TEMPERATURE HIGHER THAN THE BOILING-POINT OF MERCURY.

By J. MYERS.

JEANNEL* and Martenson† have recently published descriptions of regulators of temperature, by means of which a constant temperature higher than that of the boiling-point of mercury may be kept up. It is unnecessary to enter here into details of the construction of these apparatus; suffice it to say that air is applied in them as the expanding medium.

While engaged in a series of experiments on the process of dissociation of oxide of mercury, I required a high, but constant and only slightly varying, temperature for a considerable length of time, and for that purpose constructed a modification of Schlösing's apparatus, in which, in lieu of a mercury-reservoir, an air-reservoir is used, consisting of four glass tubes placed side by side and tied to each other, each tube 15 centimetres long by 2 centimetres diameter, This apparatus was placed into an air-bath, through a slit cut in the top of it, at the side where the door is placed, care being taken that the bath is air-

* *Polyt. Journ.*, No. 204, p. 460; *Chem. Centralbl.*, 1872, p. 497.

† *Pharm. Zeitschr. f. Russland*, 1872, No. 11, p. 136; *Chem. Centralbl.*, 1872, p. 513.

tight, while it is heated by means of gas, which can be supplied at any desired pressure. When it was desirable to heat the bath to a high temperature, say 250°, the quantity of gas required for that purpose was found too large to be regulated by the apparatus, since the distance between the supply-pipe of the gas and the caoutchouc caps (probably those connecting the above-mentioned glass tubes) had to be made too great, this being due to the great loss of heat (by radiation) from the non-heated sides of the air-bath, which, in order to be heated to the boiling-point of mercury, requires a very large bulk of gas.

It is through the kindness of Professor Gunning that I have been enabled to make these experiments, because, as the pressure usually kept up in street-gas-mains is not strong enough for this purpose, I was compelled to supply gas to the burners by means of a separate gas-holder. When the supply of gas reached a given pressure I was enabled to bring the temperature of the air-bath up to 350° by the use of four Bunsen burners, which temperature could be kept up constantly with very slight variations; with five such burners I could bring the temperature up to 362°. It is of course evident that neither Jeannèl's or Martenson's instruments, nor my own, can be used for regulating temperatures above that of the boiling-point of mercury, an observation more particularly applicable to the apparatus of the first-named gentleman, in which the outlet opening is very small; perhaps by placing the instruments in a bath of molten metal (lead or zinc, for instance) regulation of the temperature might still be possible, but the instruments are not well suited for such use. If an air-bath were so constructed that the loss of heat from the metal by radiation were either entirely prevented or greatly reduced, it might be possible for my modification of Schlösing's apparatus, if of larger size, to be found to answer for regulation and constant maintenance of higher temperatures; as long as this is not effectually done we need not hope to be able to regulate high temperatures. I say this because the assertion to the contrary made by Martenson and Jeannèl, based simply upon the fact that air is the expanding medium in their apparatus, is not proved by facts. The instrument used by me enables me to regulate with great precision the temperature of either an air- or oil-bath, since the limit of variation of temperature is only about ½°. The volume of air heated in my instrument is greater than in those alluded to, and my instrument is also more air-tight than theirs; I can therefore, upon experimental grounds, recommend the use of my modification of Schlösing's apparatus whenever a very constant and only slightly varying temperature is required.—*Ber. d. Deutsch. Chem. Gesells.*

ON SOIL ANALYSES AND THEIR UTILITY.*

By EUG. W. HILGARD, State Geologist of Mississippi.

(Continued from p. 8).

A MUCH graver defect is the failure to determine separately the organic matter ("humus") and the chemically combined water; and to this is owing, in a measure, the unsatisfactoriness of the analyses as regards information on the physical character of the soils. A large amount of water of hydration indicates in ordinary cases a correspondingly clayey soil, where heaviness in working may, or may not, be relieved by a large amount of "humus." The "volatile matter" item, however, gives us no information whatsoever on these vitally important points; and there is, unfortunately, no *simple* method by which the determinations in question can be effected even approximately. That they *should* form part of every soil analysis is obvious, if only on account of the importance of "humus."

I have attempted to obtain a reliable scale of the different degrees of "heaviness" of soils, from the determination of their maximum absorption of hygroscopic moisture at ordinary temperatures. I find that at temperatures from about +7° to +21°, the amount of aqueous vapour absorbed by a thin layer of soil exposed to a *saturated* atmosphere remains very nearly constant, being for

Very sandy soils, ...	1·5 to 2·0 per cent.
Loam soils, ...	5·0 to 8·5 ,,
Clay soils, very heavy ..	12·0 to 15·0 ,,

there being of course, all intermediate grades of hygroscopic power, as well as of "heaviness." It appears that for this interval of temperature the decrease of absolute absorbing power in the soil, resulting from the rise of temperature, is just balanced by the increased amount of vapour diffused in the air—not an unimportant circumstance with regard to vegetable life.

There are, however, two soil ingredients which interfere seriously with the correctness of the estimate as to "heaviness," derived from the coefficient of absorption, viz., *humus* and *ferric oxide*. Both of these are highly hygroscopic, yet both *counteract* the "heaviness" caused by excess of clay. Moreover, there is a class of soils (viz., fine siliceous silts) whose exceeding "heaviness" in cultivation is much complained of, yet whose absorbent power is very small.

When, as in the majority of cases, the surface soil has been directly derived from the subsoil, the disturbing effect of the "humus" may be sensibly eliminated by comparing, not the soils, but the subsoils, in this respect.* As to the ferric oxide, there are among about 200 Mississippi soils analysed but three or four whose agricultural qualities would have been seriously under-estimated by a reliance upon the coefficient of absorption alone.

But I do not for a moment admit that in a material so complex, both in its composition and mode of action, any one or few data, whether chemical, physical, or agricultural, may be relied upon to characterise the soil: or, as Professor Johnson expresses it, "to do violence to agriculture." So far from this, I consider that a proper interpetration of the analytical results must take into consideration, not only all the chemical and physical facts observed on the specimen, but all that has been or can be observed *in loco*—the location, depth, derivation, relations to drainage, &c.; as well as all that is known concerning the qualities or peculiarities of the soil, both in its natural state and in cultivation. As Professor Johnson says, it should "form part of a system of observations and trials; must be a step in some research; must stand, not as an index to a barren fact, but as the revelator of fruitful ideas."

Such, precisely, has been my object from the beginning of my researches on the soils of the Mississippi, for sixteen years past. Clearly, the difference between Professor Johnson's position and mine is one of degree only; yet this difference is not a slight one, since while, as before remarked, I have made, or caused to be made, some 200 analyses of soils and subsoils, his classic works on the growth and nutrition of plants do not contain so much as a tabular exemplification of the composition of various soils, as resulting from chemical analysis. If, then, "the probabilities of its uselessness in direct application to practice are so great," as Professor Johnson seems to hold, I have committed a grievous error, and squandered the substance of the State.

I think that the considerations already adduced should plead measurably in extenuation of my course. But I will now state succinctly what services, in my view, soil analyses may fairly claim to be capable of performing, when conducted substantially in the manner, to the extent, and under the conditions defined above.

I take it for granted that, if in the determination of the mineral ingredients we were able to distinguish clearly from one another the portion immediately available to

* Read at the Dubuque Meeting of the Am. Assoc. Adv. Sci., August, 1872.

* In such cases, the surface soil is always more sandy than the subsoil.

plants from that which is in an unavailable form, we would go far toward accomplishing what was originally claimed for soil analysis; and this Dr. Peter attempted to do by treatment of the soils with carbonated water. It cannot be doubted, however, that plants, as well as agriculturists, have at their disposal much more powerful, or at lest more *energetic*, solvents; and that, therefore, a determination of those ingredients which may fairly be considered practically within the reach of agriculture, must go deeper than does that with carbonated water.

Opinions may differ widely as to the proper strength and nature of the solvent ("*Aufschliessungsmittel*") to be selected. Hydrofluoric acid, or ignition with the alkaline earths, would evidently go too far; as no soil, probably, will ever yield up the whole of its nutritive ingredients to plants, and fertility is far from being proportional to the *whole* amount of potash, phosphoric acid, &c., contained therein.

When, however, a *partial* solvent of uniform strength is used in all cases alike, and its action continued for the same length of time, it may fairly be presumed that, *as between soils of similar origin*, the amounts so rendered soluble are, in a measure, proportional to the amounts of available nutriment present.

In using hydrochloric acid of the strength 1·11 to 1·12 sp. gr., obtained by slow steam distillation of stronger or weaker acid, rejecting the first and last portions, I have in most cases found quite a satisfactory agreement between the results so obtained and the experience of cultivators as to the productiveness and duration of the respective soils; always *provided*, that the difference in the amounts of inert sand present, of specific gravity, of depth of soil, &c., were taken into account.

The proviso is important, but that with a proper local knowledge these allowances *can* be made, and that in most cases the information thus gained regarding the nature and treatment of the soil will be vastly more complete and reliable than the judgment of any number of "old intelligent farmers," my experience has fully convinced me; witness the egregious mistakes daily made by such in the selection of new lands. Moreover, a small minority only of farmers is likely to possess the requisite "age and intelligence;" and it is quite important that the multitude of those less fortunate should have the benefit of all the help science can give them.

I will adduce but one "odious example" of a widely prevalent error in reference to the character of a class of soils that I have as yet been unable to eradicate, even from among the "old and intelligent;" who are unfortunately very much given to theorising on inadequate premises. Our prairie soils are notoriously limy; they are also "very sticky;" and the mud takes the hair off the feet of cattle, *Ergo*, every "sticky" clay soil in the State is called, considered, and treated as a "prairie" soil, especially if the hardened clods adhering above the hoofs of cattle should carry the hair with them. If such soil is unthrifty, and rusts cotton, it is because "there is too much lime in it," which "scalds" the seedlings. In matter of fact, most of these soils are notably deficient in lime, so as to be most directly and immediately benefitted by its application wherever it has been tried, in accordance with my suggestion. The lime here acts probably as much chemically as physically; the clay being rich in potash, as per analysis.* While the physical defects of these soils are doubtless the main cause of the crop failures, yet analysis has suggested a remedy which relieves, for the time being, from the necessity of the more costly improvements; lime being comparatively easy of access.

Analogous cases are far from infrequent, both in this and in the adjoining States; and I have been led to attach special importance to the determination of *lime* in soils, from the (not unexpected) rule which seems to hold good very generally, viz., that, *cæteris paribus*, the *thriftiness* of a soil is sensibly dependent upon the amount of lime it contains; while, at the same time, in the usual mode of culture without return to the soil, the *duration* of fertility is correspondingly diminished, and its cessation is very abrupt wherever much lime is present.

It may be said that, after all, this is but what, from data already known, might have been expected. Granted; then, *a fortiori*, soil analysis, involving the determination of lime, is of considerable use in determining the present and future value of soils.

In speaking of the "amount" of lime, I must be understood to refer, not so much to its absolute percentage, as to its quantity in comparison with that of potash, which, with phosphoric acid, is what all our fertilisers chiefly aim to supply. Their determination must, of course, be considered of prime importance, since their absence or extreme scarcity is fatal to profitable fertility; while, when they are present, even though *immediately* available for absorption to a slight extent only, we possess in lime, ammonia, &c., and the fallow, ready and powerful means for correcting their chemical condition.

Here again, the practical value of soil analysis is direct and indisputable. It is of no small interest to know whether the soil we intend to cultivate contains 0·75 per cent of potash and 0·25 of phosphoric acid, soluble in HCl, or only the fifth or tenth part of these amounts. *One* will bear improvement of all kinds—will pay for underdraining, terracing, &c.; while the other, quite similar in aspect perhaps, would not, according to Liebig's testimony, ordinarily be capable of profitable culture.

Again, it is well known that the same species of plants may occupy soils of widely different quality and value. True, an attentive observer will in such cases see differences in the mode of development;* yet these are often such as to escape ordinary remark, and grievous disappointments frequently arise from this source, with new settlers especially. It is of no small importance to be able to *identify*, as well as to distinguish, soils resembling each other; and this soil analysis can undoubtedly do, if there is any virtue in the law of probabilities even—admitting all that may otherwise be said against their reliability.

Even if no other direct benefits than those already mentioned could be obtained by the chemical and mechanical analysis of soils (which I do not admit, and expect to prove otherwise hereafter); even if we leave out of consideration the addition to our general knowledge which may fairly be expected to result from extensive series of such investigations, carried out upon a uniform plan, whereby accidental errors (whether caused by "birds or squirrels," or analytical and other mistakes) will be eliminated; even thus, I contend that the practical and theoretical value of soil analyses is sufficiently great to justify whatever labour and expenditure may be bestowed upon them by state and national surveys; and that the neglect with which this branch of research has of late been customarily treated, is the more to be regretted as no probable amount of private effort can accomplish what must, of necessity, be done on an extended scale and with the *prestige*, voluntary assistance, and interest not usually accorded to any but public enterprises. And with due deference to the author of the two volumes whose extraordinary merits no one appreciates more than myself, I call upon my colleagues in State surveys, especially in the West and South, to re-consider this subject before it is too late, and a legislative fiat declares their work to be "finished." It is true that the agricultural colleges must and will take up and continue, as far as possible, the investigation of the agricultural peculiarities of each State; but the special and local experience acquired by those conducting a field survey, as well as their opportunities for extensive and comparative observations, are unfortunately "not transferable," even to the finest quarto report. In order to attain their highest degree of usefulness, our agricultural

* See, for example, the article "Heavy Flatwood Soil," in my *Miss. Rep.*, 1860, pp. 276, 279.

* *Miss. Rep.* 1860, p. 203.

colleges should teach, not merely general principles, together with a sufficiency of the handicraft of agriculture; but they should be enabled to point out to each student, with reference to his particular neighbourhood, How Crops Grow, and How Crops Feed.—*Am. Journ. Sci.*

THE CHANGES WHICH COAL UNDERGOES BY EXPOSURE.

By H. ENGELMANN, E.M.

THE subject of loss of carbon, or rather of deterioration, which stone coal suffers by exposure has of late attracted much attention amongst American mining engineers and metallurgists. The different coals are not equally affected by exposure. Their texture, their chemical composition, and the impurities which they contain, exercise considerable influence. Under otherwise equal conditions those stone coals suffer most which contain a large proportion of easily decomposed hydrocarbons, or which have little cohesive strength. Gas coals, after having been stored long, make less and poorer gas than when they are fresh from the mine, and coking coals lose their coking quality, more or less; some kinds are said to deteriorate very markedly within a few days after being mined.

The nature of the changes which take place with the coal, and the conditions which influence them, still form a fruitful field for investigation. A large number of interesting experiments on this subject were made by Dr. Richter, Professor at the Mining School at Waldenburg, in Prussia, which deserve to be far more widely known than they appear to be in this country at least. A detailed account of them may be found in *Dingler's Journal*, 1870. I will confine myself to stating some of his principal results. As soon as the coal is mined it begins to absorb oxygen, rapidly at first, then more slowly. At first this action appears to be physical, but it soon becomes chemical, when the absorbed oxygen combines with the hydrogen of the coal to form water, and, with the carbon, to form carbonic acid. Heat intensifies the chemical action. Powdered stone coal fresh from the mine, heated to a temperature between 350 and 400 deg. F., increased in weight; although carbonic acid and aqueous vapour are disengaged, more weight of oxygen is absorbed. After a while a rather constant weight is obtained, and, by chemical analysis, the coal is then found to contain oxygen and hydrogen very nearly in the relative proportion in which they combine to water, which has not been the case in the fresh coal. The property of the coal thus rapidly to absorb oxygen depends mainly upon its proportion of free hydrogen. Of the carbon of the coal only a few per cent (5 or 6) combine thus rapidly with the oxygen at the stated temperature, while the rest of the carbon is far more stable.

Different stone coals heated to the boiling-point of water until their weight remained constant, would absorb in a humid atmosphere at 60° F., from 2 to 7 per cent of water, and it was remarkable to observe that some solid pitch coal would absorb three times as much water as a soft laminated coal. The faculty of absorption could not be judged from the appearance of the coal, but coals from the same stratum exhibited considerable uniformity of behaviour. The coals which absorbed most water were also those which absorbed most oxygen. Twenty grm. coal absorbed in the first twenty-four hours after mining from 2 to 9 cubic centimetres oxygen. Stone coal absorbs carbonic acid even more eagerly than oxygen, taking up three times as much of it. At higher temperatures, the chemical action of the oxygen is increased, and a slow combustion takes place.

The influence of humidity on the deterioration of coal is complicated, and Dr. Richter's experiments did not lead to very definite results in that respect. Air-dry coal absorbs the oxygen far more rapidly than moist coal, and coal which has been artificially dried absorbs it still more eagerly, taking up at the same time some nitrogen from the air. On the other hand, humidity induces decomposition of the iron sulphuret contained in most coals, which in turn accelerates the chemical changes of the coal by creating heat, by causing it to split and slack, and probably, also, by inducing chemical action between the oxide of iron formed and the coal, if not between the oxygen and coal directly.

Light appears to exercise little influence. When coal has been exposed some time, and absorbs oxygen with little avidity, this absorption is a little greater in the dark. These were the principal results of Dr. Richter.

An interesting experiment was made some years ago in Germany to test the deterioration by exposure of Silesian gas coal. A quantity of coal slack was divided in three parts. One part was directly used in the gas factory, another after having been housed one month, and the third after one month's exposure in the yard. The relative proportions of gas obtained were 135, 111, 95. The losses by exposure were, therefore, 17·2 per cent and 29·5 per cent. The gas coke from the first lot was serviceable; from the second and third unserviceable.

It can hardly be doubted that this affinity of the oxygen for the coal has contributed much towards determining the quality of the coal which the different strata now present, but acting slowly in the course of ages, the effect has not been an apparent decomposition, but merely a difference of quality. The bituminous coking and gas producing coals have been least affected. They retain the largest proportion of hydrogen uncombined with oxygen and the least combined. The sinter or sand coals, which coke little or not at all, and furnish a poor gas, contain less hydrogen uncombined with oxygen, and more oxygen and hydrogen combined, than if they had been partly deteriorated by exposure. How little chemical equilibrium exists in a coal stratum is evident from the immense amount of carburetted hydrogen gas which is evolved in the coal mines, even in those which are not subject to dangerous accumulations of it in the form of fire-damp, and which in many, especially in deeper mines, can be heard escaping in minute bubbles from the sides of the rooms, making a peculiar noise. The quality of the roof and the quality and thickness of the superincumbent rock formations have exercised an important influence in determining the quality of the coal strata. Not seldom the deeper strata of a coal basin are the most bituminous ones. The more recent brown coals, the coals which are so extensively developed throughout the region of the Rocky Mountains, which are of cretaceous age, and present the appearance of stone coals, contain generally little hydrogen compared to their large proportion of oxygen. They should on that account not be apt to decompose readily, but the large amount of hygroscopic water which they contain, and their lack of cohesive strength, render many of them an easy prey to deterioration by exposure. I have seen many car-loads brought into this city (Salt Lake), of which the uppermost pieces, from an exposure of several days to the scorching sun and drying winds, were cracking and exfoliating very much like burnt lime in a moist atmosphere. These coals would certainly be of superior quality if they had been buried deeper in the bowels of the earth, and protected by heavy deposits of dense rock strata, which would have prevented the loss of so much of their bitumen, and rendered the access of oxygen more difficult. These coals are, however, not equally devoid of bitumen, and a locality in Sanpete Valley, U. T., presents a curious example of the influence of a solid casing. Near the village of Wales there is an outcrop of this brown coal, which is far more bituminous than the average. It is encased between solid beds of a slaty limestone, which forms a foot wall and roof of great stability. There is no clay seam or shale intervening. The whole thickness of the bed is about forty inches at this point, which appears to diminish to both sides, but it is not all coal. In its upper part it encloses several inches

of slate, and in its lower part an irregular seam of the same slaty limestone, from 0 to 10 inches in thickness. The coal itself is very solid, has a subconchoidal fracture, and, aside from the slate, contains a large proportion of ashes. Thus armour-plated against the inroads of decomposing agencies, it has retained considerable bituminous matter at the cost of purity. This coal is remarkable also on account of the vast number of small fresh water shells which are associated with it, and which must render it rich in phosphorus. Not only is the limestone above, below, and the coal full of these white shells, but the block slate is also crammed full of them, and even the coal itself near the slates.—*Engineering and Mining Journal.*

LIQUID GLUE PREPARED FROM SACCHARATE OF LIME.

A solution of 1 part of loaf-sugar in 3 parts of water, when spread on paper, imparts to it neither gloss nor strength, for the size does not adhere to the fingers when moistened. If, however, we add to the sugar the fourth part of its weight of slaked lime, and warm it to 145° to 165° F., then let it macerate some days, shaking it frequently, we shall find the greater part of the lime dissolved. The solution decanted from the lime sediment is then found to have the properties of mucilage, and a coat of it possesses gloss and firmness.

If we soak 3 parts of glue broken in small pieces in 12 to 15 parts of this saccharate of lime, then on warming it the glue dissolves rapidly, and remains liquid when cold without losing its strength, as glue does when treated with acid. Glue of any desirable consistency may be prepared by varying the amount of saccharate of lime added; the thicker glue keeps its muddy colour, the thin becomes clear on standing.

Gelatine dissolves in this solution of lime and sugar without previous soaking; even old gelatine, which has become insoluble in hot water, is soluble in this compound. This glue has great adhesiveness, and admits of very many uses; it cannot, of course, be used on colours that are injured by the lime, as, for example, chrome-yellow, Paris-blue, zinc-green, Behringer's green and carmine. Ponceau made from carbolic acid is changed into a beautiful carmine colour. When warming the glue to dissolve it, a strong smell of glue is given off, but this is destroyed by a few drops of oil of lavender; a small admixture of 2 to 3 per cent of glycerine is also an advantage. Carbonic acid acts upon the lime when the glue is exposed a long time to the air, producing little white specks, without, however, affecting its adhesive and preservative power.—*Journal of Applied Chemistry.*

PROCEEDINGS OF SOCIETIES.

ROYAL IRISH ACADEMY.

At the last general meeting of the academy, Dr. Sullivan read an interesting paper entitled "*Notes on the Ammonia present in Fungi.*" The author had been engaged in these investigations for many years. The present paper dealt more particularly with the chemistry of the common edible mushroom (*Agaricus campestris*). Dr. Sullivan was of opinion that the ammonia existed in the juice of the mushroom, and was not a product of decomposition. It might, and probably did exist in the form of an amide, and occurred in very large quantities. The author also gave it as his opinion that ammonia is constantly being eliminated from the plant during its growth.

Dr. Moore (Botanic Gardens) suggested that, in operating upon the mushroom, the chemist was really only examining the juices of the flower, and that therefore it differed, and was no criterion of the presence of ammonia in ordinary juices.

In the discussion that followed, Mr. Tichborne remarked that in boiling large quantities of the juice of the mushroom, volumes of ammonia were given off at one particular stage, which certainly tended to show that it existed in some such form as an amide, which at a particular temperature was split up into molecules of greater stability.

The Chairman (Professor Jellett) then detailed some experiments he had made in connection with the rotary power of mushroom juice in the saccharometer.

A second paper was read by Professor Sullivan, "*On the Dyeing Materials of the Ancient Irish.*"

MISCELLANEOUS.

Shaping Soft Rubber with a File.—We hear from Professor Morton, President of the Stevens Institute, that the ordinary thick sheet rubber used in making up lantern tanks and for many similar purposes, may be readily dressed into exact shape with a file, if only it is supported by being clamped between plates of wood or metal in the vice. The file is used dry, and in all respects as in working on wood or metal.

The Luminiferous Ether.—Though compelled to think of space as unbounded, there is no mental necessity to compel us to think of it either as filled or as empty; whether it is filled or empty must be decided by experiment and observation. That it is not entirely void, the starry heavens declare, but the question still remains: Are the stars themselves hung *in vacuo?* Are the vast regions which surround them, and across which their light is propagated, absolutely empty? A century ago the answer to this question would have been, "No, for particles of light are incessantly shot through space." The reply of modern science is also negative, but on a somewhat different ground. In support of the conclusion that the celestial spaces are occupied by matter, it is able to offer proofs almost as cogent as those which can be adduced for the existence of an atmosphere round the earth. The notion of this medium must not be considered as a vague or fanciful conception on the part of scientific men. Of its reality, most of them are as convinced as they are of the existence of the sun and moon. The luminiferous ether has definite mechanical properties. It is almost infinitely more attenuated than any known gas, but its properties are those of a solid rather than of a gas. It resembles jelly rather than air. A body thus constituted may have its boundaries; but, although the ether may not be co-extensive with space, we at all events know that it extends as far as the most distant visible stars. In fact it is the vehicle of their light, and without it they could not be seen. This all-pervading substance takes up their molecular tremors, and conveys them with inconceivable rapidity to our organs of visions. It is the transported shiver of bodies countless millions of miles distant which translates itself in human consciousness into the splendour of the firmament at night. If the ether have a boundary, masses of ponderable matter might be conceived to exist beyond it, but they could emit no light. Beyond the ether dark suns might burn; there, under proper conditions, combustion might be carried on; fuel might consume unseen, and metals be heated to fusion in invisible fires. A body, moreover, once heated there, would continue for ever molten. For, the loss of heat being simply the abstraction of molecular motion by the ether, where this medium is absent no cooling could occur. A sentient

being, on approaching a heated body in this region, would be conscious of no augmentation of temperature. The gradations of warmth dependent on the laws of radiation would not exist, and actual contact would first reveal the heat of an extra ethereal sun.—*Tyndall.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, December 23, 1872.

In addition to a series of papers strictly relating to other departments of physical sciences, this number contains the following original memoirs relating to chemistry:—

Action of Iodine upon some of the Hydrocarbons Belonging to the Aromatic Series.—P. Schutzenberger.—This essay contains the record of a series of experiments made with the view to ascertain the action of iodine under pressure (sealed tubes), and at a high temperature, upon certain hydrocarbons. Benzol gave a negative result; naphthaline was quite carbonised, but toluen is dehydrogenised, the result being the formation of new hydrocarbons—among these benzyl-toluen, $C_{14}H_{14}=2C_7H_8-H_2$; and a red-coloured solid body, soluble in benzine and in chloride of carbon, fusion-point 100°, formula,—

$$2n(C_{14}H_{11})=2n(C_7H_8-H_5).$$

Reciprocal Conversion of Inactive Tartaric and Racemic Acids; Preparation of Inactive Tartaric Acid.—E. Jungfleisch.—Reserved for full translation.

December 30, 1872.

This number contains the following origina papers and memoirs more particularly relating to chemistry:—

On some Reactions of the Chlorides of Boron and Silicium.—L. Troost and P. Hautefeuille.—When the vapours of chloride of boron are caused to pass through a non-glazed porcelain tube at red-heat, the chloride is partly decomposed, chlorides of aluminium and silicium are evolved, and borate of alumina formed in the tube. If the chloride of boron is made to pass through a red-hot glazed porcelain tube the glaze is acted upon, and there is also formed, in addition to the chlorides above named, double chloride of aluminium and potassium. Pure chloride of silicium does not act upon porcelain even at the highest temperature; but both this chloride and that of boron under the same conditions act upon many other substances, such as zirconia, titanic acid, &c., forming chlorides thereof.

Quantitative Estimation of Manganese in Iron Ores, Pig-Iron, and Steel by a Colorimetric Process.—P. Pichard.—Reserved for translation, a remark also applying to thefollowing paper:—

Volumetric Estimation of Small Quantities of Arsenic and Antimony.—A. Houzeau.

Presence of Methyliac in Methyl-Nitric Ether and in Methylic Alcohol.—M. Lorin.—It appears that on testing samples of methyl-nitric ether and of methyl-alcohol, the author found therein a substance which on being treated with hydrochloric acid yielded methyliac hydrochlorate. The process of the operation is described at great length, and it further appears that the samples operated upon were relatively pure.

Use of Cupric Liquors for the Estimation of Sugar.—L. Possoz.—When the cupric liquors used for the estimation of sugar are either treated with carbonic acid or with alkaline bicarbonates, there is precipitated from these fluids some carbonate of copper, while another portion of copper remains in solution. This (tartrate of copper and potassa, or of soda + aikaline carbonates) is not decomposed by pure cane sugar at temperatures between 60° and 95°, but is readily decomposed by inverted sugars. The fluid freed from caustic alkalies cannot give rise to the errors lately mentioned in various periodicals.

Researches on the Spectrum of Chlorophyl.—J. Chautard.

Annalen der Chemie und Pharmacie, No. 1, 1873.

On Sulphate of Iron Precipitated by Alcohol, and on the Quantity of Water Contained in the Double Sulphate of Iron and Ammonia, and of the Double Sulphate of Iron and Potassa.—L. Caro.—This paper, written chiefly to rectify some experiments made by Barckhausen and Rheineck, mainly confirms what is already known, viz., that the composition of protosulphate of iron precipitated by alcohol is the same as that of the crystallised salt; while, as regards the two other salts, Rheineck's statement as to their composition is proved to be erroneous.

On Hydrogen Shifting (Wasserstoff Verschiebung) on the Carbon Skeleton (Kohlenstoff Skelet) of Organic Compounds.—W. Heintz.—This essay, illustrated by a series of complex formulæ, is not well suited for abstraction.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, August, 1872.

This number contains no original papers relating to chemistry, but we quote the title of Dr. Vom Rath's paper on—

The Crystallographic System of Leucite.—Illustrated by several engravings.

Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, Nos. 11 and 12, 1872.

These numbers contain no original papers relating to chemistry.

Bulletin de la Société Chimique de Paris, December 1, 1872.

The original papers in this number have been already abstracted from other French periodicals.

Le Moniteur Scientifique Quesneville, January, 1873.

Anthracen and its Derivatives.—E. Kopp.—The continuation and end of this exhaustive essay treats on the modes of applying artificial alizarine and purpurine, native alizarine, and the extracts of madder. There are a large number of practical receipts and directions for the use of the dyer and calico printer.

Memoir on Two Acids Found in the Mother-Liquors of Coralline.—A. Commaille.—This essay, treating on parathionic and thioamylic acids, and on an acid isomeric with sulphamylic acid, is a full account of the author's researches already alluded to (see CHEMICAL NEWS, vol. xxvi., p. 300).

Method of Purification of Rosolic Acid.—Ch. Girard.—In the introduction to this paper the author gives a *resume* of the methods by which pure phenol or cresylol may be converted into rosolic acid, while, further, the experiments of Wanklyn and Caro with rosaniline, and those of Liebermann with the same substance (the final result in each case being the formation of rosolic acid) are spoken of. The author next describes at length a rather complex process of purifying the rosolic acid obtained from either rosaniline or any of its salts by the aid of water under high pressure at 205°. The substances resulting from this reaction are first treated by the author with aniline, heat being applied. Thus there is formed azuline blue, which is first treated with hydrochloric acid, then washed with water, dried and reduced to powder; this is treated with caustic potassa. The insoluble residue is again treated with dilute hydrochloric acid, then washed with distilled water, and having been dried, the residue is treated with the vapours of either chloroform or crystallisable benzine; again dried, treated with alcohol, filtered, and the solution evaporated. The residue is treated, under pressure at 100°, with alcoholic potassa solution, whereby aniline is formed (from the triphenylic-rosaniline present in the matter), and rosolate of potassa, which, after the addition of water, is decomposed by an acid, yields flocculent rosolic acid. This is further purified, after washing and drying, by solution in boiling absolute alcohol; from the hot filtrate of that solution the pure rosolic acid is deposited on cooling in a crystalline state.

New Method of Preparing the Hair of Rabbits and Hares to be Used in Felt Hat Making, Without the Use of Mercury.—M. Hillairet.—A detailed account of some newly-devised processes, by the application of which the use of mercury may be avoided in the preparation of felt.

Preservation of Timber and Wood by Means of Tar.—Dr. Quesneville.—This essay contains a condensed account of the results of practical experiments made in France and Belgium by different persons to ascertain the value of tar as a preservative of timber, and the best methods of applying it.

Memoirs on the Estimation of Phosphoric Acid.—T. Schlœsing and G. Ville.

Bibliography.—Under this heading attention is called to the following work:—"Histoire de la Botanique, de la Minéralogie et de la Géologie Depuis les Temps les Plus Réculés jusqu'à nos Jours," par Dr. F. Hoefer, the eminent editor of the well known "History of Physics and Chemistry."

Although not belonging to chemistry, we call attention to the two following essays:—

The Floods of the Seine.—H. Parville.—This memoir contains not only important historical, but hydrographical and geological information concerning the causes of the rapid rising of the rivers in general.

Febrifuge and Anti-Periodic Properties of the Leaves of the Laurus Nobilis.—G. Deray.

La Revue Scientifique de la France et de l'Etranger, December 21, 1872.

Researches on Dulcite and Sugars in General.—Dr. G. Bouchardat.—This paper contains a brief *resume* of the author's researches, published in the form of an inaugural dissertation. The first part treats on dulcite, and on the relation existing between that substance and the glucoses which yield mucic acid, and on the question whether all the glucoses can be viewed as the aldehydes of hexatomic alcohols. Next the action of different reagents (dilute acids, sodium amalgam) upon various kinds of saccharine substances is described; and in the second part of the essay the combinations of dulcite with acids is fully detailed. Dulcite as well as mannite are hexatomic alcohols, and the combinations with acids are veritable ethers.

Geology and Paleontology of Provence (South Eastern France).—A. F. Marion.—Illustrated by woodcuts and a map; an excellent lecture of the geology and paleontology of this locality.

Regularisation of the Heat in Warm-Blooded Animals.—Dr. Rosenthal.—A physiological essay.

December 28, 1872.

Bibliography.—Attention is called to "Histoire de la Céramique," par Albert Jacquemart, 1 vol.: Paris, Hachette, prix 25 francs. The author begins from the remotest periods of antiquity, and refers to all nationalities and countries.

Annales des Mines, No. 4, 1872.

This number contains no original papers relating to chemistry, but we call attention to the two following monographs.

Studies on Blast-Furnaces.—L. Gruner.

Notes on the Mechanical Preparation (Washing, Screening, &c.) of Coals, and on the Making of Coke Abroad and in France.—A. Pernollet.—These essays are copiously illustrated with engravings.

Journal de Pharmacie et de Chimie, December, 1872.

In addition to several original papers strictly relating to pharmacy, this number contains the following brief paper relating to chemistry:—

Action of Ether upon Iodides.—Dr. J. E. de Vry.—The author states, in reference to an observation made by Ferrières concerning the decomposition of iodides by ether, that several years ago he tried a similar experiment leading to the same result; but when the ether of commerce was first thoroughly shaken up with a concentrated solution of sulphate of protoxide of iron, and next with milk of lime, and then rectified by distillation, *no* action of the ether upon the iodides was observed. The author further observed that, while he resided in Java, he always ordered the ether sent to him from Europe to be rectified in the manner just described, because so treated it remained perfectly pure and without any action upon iodides even in that warm climate, provided the bottles containing it were well stoppered and kept quite full.

Les Mondes, December 26, 1872.

This number contains no original papers relating to chemistry, but it gives an exhaustive programme of—

A New High School for Agronomic and Forester's Sciences and their Application, to be shortly Inaugurated at Vienna.—It appears that this institution, founded by the Austro-Hungarian Government, will be in every respect, one of the most complete of the kind in Europe.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, December 5, 1872.

Manufacture of Stearine Candles.—M. Venèque.—The detailed accouut of this industry as carried on by the author.

Description of a Newly-Contrived Muffle Furnace to be Heated by Petroleum.—M. Wiesnegg.—This paper, illustrated by woodcuts, contains an account of muffle furnaces so constructed that petroleum may be used as fuel, according to a system devised by H. Sainte-Claire Deville.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 19, 1872.

From the protocol of the meeting, the proceedings of which are published in this number, we find that Dr. Oppenheim alluded to the fact that an eminent French *savant*, Aug. Cahours, desired to become a member of the Society; he regarded this as a sign of growing goodwill between the two nations, and of increasing oblivion of the past. He then briefly sketched the eminent scientific discoveries of Cahours, who was unanimously elected a member in the usual manner. The president, Dr. A. W. Hofmann, then communicated to the meeting that their fellow member, Dr. Heinrich Ludwig Buff, died at Prague on the 2nd of December last, at the age of forty-five years. The deceased, a well and deservedly known chemist, formerly one of Professor Liebig's assistants at Giessen, was Professor of Chemistry at the German Polytechnic School at Prague, and an industrious collaborator of many German scientific works, and one of the editors of the *Jahresbericht*.

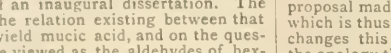
The following original papers are also found in this number:—

Atomic Weight of Uranium.—C. Rammelsberg.—The contents of this essay, elucidated by a large number of formulæ, treat on the proposal made by Mendelejeff to double the atomic weight of uranium, which is thus brought from 120 to 240. The author points out the changes this makes in the formulæ of the uranium compounds, and the analogy thus effected with the compounds of molybdenum, tungstenum, and thorium. By taking the atomic weight of uranium as 240, it becomes the heaviest of all the elements.

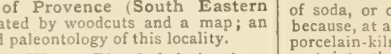
Observations on Silicic Acid.—C. Rammelsberg.—The main gist of the first part of this paper is that the amorphous silicic acid, as frequently obtained in analysis, is only soluble after ignition, which renders it anhydrous in a boiling concentrated solution of carbonate of soda, or of potassa when the ignition was comparatively gentle; because, at a rather high temperature, although far below that of the porcelain-kilns, amorphous silica is converted, either wholly or in part, into the crystalline state (tridymite), and its sp. gr. is then 2·3. Some other amorphous bodies, berylla, titanic, zirconic, niobic, and tantalic acids, for instance, are similarly converted into crystalline bodies. In the second portion of this paper, the author observes that the quantity of water contained in silica, precipitated from alkaline silicates by acids, and dried, either over strong sulphuric acid or at 100°, varies, so as to exhibit hydrates of the formula $n SiO_2 + aq$, the value of n being in this case equal to from 4 to 8. Air-dried silica, even when apparently quite dry, may contain from 13 to 36 per cent of water.

Chlorine Derivatives of Aceton.—E. Mulder.—This exhaustive essay, elucidated by a very large number of formulæ, treats on the mode of preparation and properties of dichloraceton, α monochloraceton, and on the combinations of the former with hydrosulphuret of potassium and cyanide of potassium. The author incidentally observes that monochloraceton becomes of a beautiful carmine colour by the addition of excess of caustic potassa solution.

Diglycolamido Acid Diuramide.—E. Mulder.—This essay, containing a large number of complex formulæ, treats, after referring to Baeyer's researches on the synthesis of hydantoin, on diglycolamido acid diuramide—

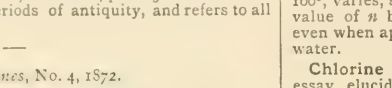


a colourless, crystalline body, insoluble in alcohol, slightly soluble in cold, and more so in hot, water; combines with platinic chloride. It also treats on triglycolamido acid triuramide—



a body to be further investigated, as likewise is an amido-acetyl-urea (hitherto unknown) isomeric with glucocyamine, amido-acetyl-urea—

Glucocyamine—



Formation of the Acids of Sulphur.—J. Thomsen.—An exhaustive thermo-dynamic monograph.

Reduction of Mononitro-Napthoe Acid.—P. v. Rakowski.—After referring to the researches of Hofmann, Merz, Küchenmeister, and others, the author goes on to describe at length the preparation, first, of napthoe acid, and next of the mononitro compound thereof. The latter is further submitted to the action of metallic tin and hydrochloric acid, thereby yielding, after purification, a compound—

$$C_{22}H_{16}N_2O_2,$$

a crystalline compound, combining with neither acids nor bases, fusing at 174°, soluble, unaltered in strong sulphuric acid, and yielding, by the addition of water, another substance which has to be further investigated.

Observations on Hydrochinon and Substances related thereto.—O. Hesse.—Notwithstanding its high intrinsic merits, this essay, elucidated by very elaborate and complex formulæ, is not suited for abstraction.

Action of Potassium upon Benzol, and that of Bromethyl upon Naphthalin Potassium.—H. Abeljanz.—By heating absolutely pure and anhydrous benzol in a sealed tube with potassium to from 240° to 250°, a combination, by addition of the two bodies, is obtained; benzol potassium in a dry state, is a very explosive compound, which is also violently decomposed by water: when this decomposition takes place more slowly, under a layer of benzol, the result is the formation of diphenyl. The naphthalin potassium is violently acted upon by bromide of ethyl; among the products of this reaction is a hydrocarbon, $C_{20}H_{12}$.

History of the Azo Compounds.—S. Alexejeff.—The chief aim of this brief notice is to point out that several azo compounds, lately described in the *Berichte* and other scientific periodicals, have

been long since known and fully described in the Russian language, not only in monographs but also in publications issued in Russia, printed in either the French or German languages. The author quotes the titles and other particulars at length.

Nitro Compounds of the Fatty Series.—V. Meyer and A. Rilliet.—The third part of a monograph on this subject; this section treats on brom-nitroethan and normal nitro-propan.

Nitro Compounds of the Fatty Series.—V. Meyer and C. Chojnacki.—This fourth portion of the exhaustive monograph treats on pseudo nitro-propan, and contains an elaborate tabulated form, too lengthy for reproduction, exhibiting the reactions of sodium nitro-methan, sodium nitro-ethan, sodium nitro-propan (normal), sodium nitro-propan (pseudo), with mercuric chloride, ferric chloride, barium chloride, cupric sulphate, plumbic acetate, and argentic nitrate.

On Aromatic Amido Acids containing Alcohol Radicals.—P. Griess.—This memoir is termed a preliminary notice; it is divided into the following sections, copiously illustrated by a large number of complex formulæ—action of iodethyl upon amido benzoate of potassa; action of nitrous acid upon ethylamido benzoic acid; action of iodallyl upon amido benzoate of potassa; action of iodmethyl upon amidoanisic acid.

Isomorphism of the Anhydrous Sulphates of the Alkaline Earths.—A. Arzruni.—This paper treats on cœlestine (native sulphate of strontia) in a chemico-crystallographic point of view. The author analysed six varieties of this mineral as found near Lake Erie, at Rüdersdorf (near Berlin), in Sicily, near Bristol, near Mokkatam (Egypt), and Pschow (Russia); and all these minerals are found to be free from sulphate of baryta, but contain a small quantity of sulphate of lime. The method of analysis, decomposition of the cœlestine by means of a solution of carbonate of soda in sealed tubes placed horizontally in a water-bath, and kept there for at least 12 hours, is minutely described.

On Cyan-Carbonic Acid Allyl-Ether.—R. Wagner and B. Tollens.—This monograph is not well suited for abstraction, an observation applying also to the following essay:

On Dibenzyl-Dicarbonic Acid.—A. P. N. Franchimont.

An Ether of Pyrouvic Acid.—A. Oppenheim.—The rather cumbrous and difficult method of preparing this ether is described at great length. The ether, pyrouvate of methyl, is a fluid; boils at between 134° and 137°, sp. gr. at 0°=1·154, formula—

$$CH_3-CO-CO_2CH_3.$$

On Polymeric Modification of Isobutyl-aldehyde.—G. A. Barbaglia.—The para-isobutyl-aldehyde herein alluded to is a solid crystalline body; fusion-point, 59° to 60°; vapour density = 105·55; formula, $3C_4H_8O=C_{12}H_{24}O_3$.

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3620. J. C. Ramsden, Lightcliffe, Halifax, and J. M. Tankard, Bradford, Yorkshire, "New and improved methods or processes of and apparatus for staining or dyeing fibrous filaments when in the raw or when in a partly prepared state.—Petition recorded December 2, 1872.

3687. R. S. Best, Goole, Yorkshire, "Improvements in the manufacture of phosphates of soda and potash and chloride of ammonium; also in the manufacture of chemical manures and alkalies."—Petition recorded December 5, 1872.

3692. M. Henry, Fleet Street, London, "Improvements in preserving and protecting ships' sheathing and other metal surfaces exposed to the action of sea-water."—A communication from M. L. Ehrmann, Boulevart Sainte Martin, Paris.

3696. T. Green, Ouseburn, Newcastle-on-Tyne, "Improvements in the treatment of bones and other articles, and in apparatus for the same."—Petitions recorded December 6, 1872.

3736. W. R. Lake, Southampton Buildings, London, "An improved insulating compound for telegraphic purposes."—A communication from Z. G. Simmons, Kenosha, Wisconsin, U.S.A.—Petition recorded December 9, 1872.

3755. H. Y. D. Scott, C.B., Ealing, Middlesex, "Improvements in the treatment and utilisation of sewage water."

3763. R. S. Casson, Brierley Hill, Staffordshire, "Improvements in puddling furnaces, heating furnaces, and other reverberatory furnaces used in the munufacture of iron and steel."—A communication from P. A. Dormoy, Troyes, France.—Petitions recorded December 11, 1872.

3775. J. Hunt, Ewell, Surrey, "Improvements in the manufacture of gunpowder and in the apparatus employed therein."—Petition recorded December 12, 1872.

NOTICES TO PROCEED.

2337. T. Richardson, J. W. Richardson, and A. Spencer, West Hartlepool, Durham, "Improvements in the manufacture of iron and steel, and of revolving puddling furnaces or convertors, and apparatus to be employed therein."—Petition recorded August 6, 1872.

2351. G. M. Moore, Liverpool, "Improvements in the process of evaporating or concentrating alkaline liquors in the manufacture of caustic soda, caustic potash, soda-ash, and other similar substances; also for heating or boiling and refrigerating solutions in breweries, distilleries, chemical and other manufactories, and in the apparatus employed therefor."—Petition recorded August 7, 1872.

2446. A. R. Arrott, Saint Helens, Lancashire, "Improvements in the manufacture of carbonate of soda,"—Petition recorded August 16, 1872.

2687. B. B. Standen, Blackheath, Kent, "Improvements in collecting and treating human excrement, both solid and liquid, and in the treatment of other animal urine, also in the means or apparatus employed therein."—Petition recorded September 11, 1872.

2711. W. D. Ruck, Greenwich, Kent, "Improvements in the manufacture of gas."—Petition recorded September 12, 1872.

2943. E. J. Payne, Packwood, Warwickshire, and W. Clarke, Dudley, Worcestershire, "Improvements in converting or partially converting iron into steel."—Petition recorded October 5, 1872.

3160. W. T. Cooper, Oxford Street, Middlesex, "Improvements in preparing or making up medicated and other effervescing mixtures."—Petition recorded October 24, 1872.

3642. C. W. Siemens, Great George Street, Westminster, "Improvements in smelting iron and steel, and in furnaces and apparatus employed in connection therewith, parts of which improvements are also applicable to regenerative gas-furnaces generally."—Petition recorded December 3, 1872.

PATENTS SEALED.

1845. W. Bull, Chancery Lane, Middlesex, "Improvements in making salt from brine."—Dated June 19, 1872.

1878. J. Tourre, Avignon, France, "Improvements in obtaining colourable matters derivable from madder, munjeet, and other allied roots."—Dated June 21, 1872.

1948. F. J. Cheesbrough, Liverpool, "Improvements in the process of manufacturing oil and oil-cake from seeds, and in the machinery to be used therein."—A communication from W. B. Fisher, Newark, New Jersey, U.S.A.—Dated June 27, 1872.

2717. W. S. Dixon, Grosvenor Place, Middlesex, "Improvements in the manufacture of plute iron or refined metal."—Dated September 13, 1872.

2988. J. Young, Kelly, Renfrewshire, N.B., "Improvements in treating liquors containing ammoniacal compounds in order to obtain products therefrom."—Dated October 10, 1872.

3094. E. C. Nicholson, Herne Hill, Surrey, "Improvements in the production of colours for dyeing and printing,"—Dated October 19, 1872.

NOTES AND QUERIES.

Sulphur Dioxide.—On page 126 of Roscoe's "Chemistry," the molecular weight of sulphur dioxide is given as 65. How is this got?—E. T.

Analysis of Sugars.—Would your readers kindly inform me the best book published that treats on the complete analysis of sugars?—SUBSCRIBER.

Mycoderma Vini and M. Aceti.—I shall be glad of a reference to where I shall find the fullest descriptions of Mycoderma Vini and Mycoderma Aceti, and of other organisms found in wines.—A. Z.

Acid in Crude Sugar.—Can any of your readers inform me what is the best way to determine the amount of acid in crude sugar when the percentage is very small? I have it to do frequently, and manage in this way, which is not always satisfactory:—A few grammes of sugar are weighed out, dissolved in water, tested with litmus paper, and the solution found to be distinctly acid. Normal soda is then added from a pipette divided into hundredths of a centimetre, and the solution tested by dipping in slips of litmus paper after the addition of one or two drops. This is somewhat clumsy, and probably not very accurate. Again, how is the acid to be reckoned, or rather as what? In making my reports I calculate it as acetic acid.—J. M. MERRICK, Laboratory, 59, Broad Street, Boston, Mass., U.S.A.

Analysis of Hyposulphites, Sulphides, and Sulphites in the same Solution.—(Reply to "Alkali.")—Estimate the sulphides by means of an ammoniacal solution of zinc, using a drop of lead solution on filtering paper as an indicator. Add to another sample of the original solution some acetate of zinc (or chloride or sulphate of zinc, with a few drops of acetic acid), dilute to 300 c.c., pour through a dry filter, and save two portions of 100 c.c. of the clear filtrate. In one of these estimate the hyposulphites and sulphites together by iodine solution, in the other destroy all hyposulphite by boiling with dilute sulphuric acid, collect and weigh the sulphur,—either as such or after oxidation as barium sulphate,—and calculate the hyposulphites from it: the sulphites are found by subtraction from the last testing (with iodine). Test, as a check, the original solution direct by iodine solution (without removing the sulphides by zinc solution; the result might so agree with the sum of the single determinations made as above. Another method is this:—Estimate the sulphides by zinc, and the sum of the sulphites and hyposulphites as above; also the sulphates in the usual manner. Then oxidise all sulphur compounds to sulphates by heating the solution with potassium chlorate and hydrochloric acid, and estimate the sulphate now present. An easy calculation will show the amount of sulphur present in excess over what it would be if the iodine determination had only shown sulphites, and this excess corresponds to the hyposulphites. In both methods the polysulphides are estimated along with the monosulphides.—GEORGE LUNGE.

MEETINGS FOR THE WEEK.

MONDAY, Jan. 13th.—Royal Geographical, 8½.
— Medical, 8.
TUESDAY, 14th.—Royal Institution, 3. Prof. Rutherford, "On the Forces and Motions of the Body."
— Civil Engineers, 8.
— Photographic, 8.
WEDNESDAY, 15th.—Meteorological, 7.
— Society of Arts, 8. C. W. Vincent, F.C.S., "On the Sulphur Deposits of Kriswick, Iceland."
THURSDAY, 16th.—Royal, 8½
— Chemical, 8. Mr. Grimshaw, "On Ethylamyl." C. Schorlemmer, "On Hepttanes from Petroleum." S. Carnelley, "On Vanadaes of Thallium." C. T. Kingzett, "On the Formation of Sodium Sulphide by the Action of Sulphuretted Hydrogen upon Sodium Chloride."
— Royal Society Club, 6.
— Royal Institution, 3. Dr. Debus, F.R.S., "On Oxidation."
FRIDAY, 17.—Royal Institution, 3. Wm. Spottiswoode, LL.D., "On the Old and New Laboratories at the Royal Institution."
SATURDAY, 18.—Royal Institution, 3. Edward A. Freeman, D.C.L., "On Comparative Politics."

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Artificial Respiration in Concussion and Compression—Influence of Artificial Respiration on the Circulation.—Respiratory Curves in the Blood pressure—The Number of the Red Blood-corpuscles in Mammals, Birds, and Fishes (Dr. Ferrier).
On a Hæmatozoon inhabiting Human Blood (Dr. Cobbold, F.R.S.).
On the Fecundation and Development of the Ovum of the Rabbit (Dr. Klein).
Recent Papers.

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Minute Organisms and Disease (Dr. J. F. Payne).
Septicæmia—Syphilitic Disease of the Small Arteries of the Encephalon (Dr. Hughlings Jackson).
Diseases of Bones (Mr. Marcus Beck).

MEDICINE.

Progressive Muscular Atrophy.—Neuralgia from Exostosis.—Epilepsy (Dr. Lockhart Clarke, F.R.S.).
Galvanism of the Sympathetic in Graves's (Basedow's) Disease.—On Endocarditis and Embolism (Dr. Bruce).

SURGERY.

Resection of the Knee-joint (Mr. MacCormac).
Tubercular Disease of the Urinary Mucous Membrane.—Death from Ether (Mr. J. W. Haward).
Recent Papers.

MATERIA MEDICA AND THERAPEUTICS.

The Chinese Materia Medica.
On Propylamine (Dr. S. Ringer).
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OBSTETRICS.

Contribution to the Study of Puerperal Septicæmia.—Puerperal fever (Dr. Playfair).

PUBLIC MEDICINE AND EPIDEMIOLOGY.

The Diffusion of Cholera in India (Dr. Corfield).
Droitwich Saline Springs and Baths (Dr. J. Macpherson).

REVIEWS.

Transactions of Obstetrical Society of London (Dr. Edis).

NEW INVENTIONS.

Maurland's New Reflecting Otoscope.

MISCELLANY.

The Emperor Napoleon III.—Sir W. Jenner.—Society of Biology.—Dr. Hoppe-Seyler, &c.

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THE CHEMICAL NEWS.

VOL. XXVII. No. 686.

ON THE

FORMATION OF SODIUM SULPHIDE BY THE ACTION OF SULPHURETTED HYDROGEN UPON SODIUM CHLORIDE AT HIGH TEMPERATURES.

By C. T. KINGZETT.

THAT sodium sulphide was so formed the author first found by the passage of coal-gas over sodium chloride at a red heat. Concluding that its formation depended upon the presence of sulphuretted hydrogen in the gas used, experiments were made in which pure sodium chloride was exposed to the action of washed and dry sulphuretted hydrogen, at various temperatures, for periods varying from ten minutes to three hours. Sodium sulphide was always formed in amount varying and equal to from 0·93 to 15 per cent of the sodium chloride used. The temperature most conducive to the formation of sodium sulphide was found to be one sufficient to thoroughly fuse the salt used; and the rate of the current of sulphuretted hydrogen must be rapid enough to carry off at once the hydrochloric acid set free. The sulphuretted hydrogen used was sometimes obtained by the passage of pure hydrogen over fused sulphur, but generally by the ordinary methods.

Other experiments showed that neither hydrogen nor sulphur produced sodium sulphide when transmitted over sodium chloride at a red heat. So that when it is formed by the action of sulphuretted hydrogen it must be the result of a direct reaction.

$$2NaCl + H_2S = Na_2S + 2HCl.$$

More experiments are in progress, to decide whether this is the only and ultimate reaction that takes place; but from examinations of the gaseous products, the author inclines to the belief that it is not.

ON A NEW METHOD OF VIEWING THE CHROMOSPHERE.*

By J. N. LOCKYER, F.R.S., and G. M. SEABROKE.

THE observations made by slitless spectroscopes during the eclipse of Dec. 11, 1871, led one of us early this year to the conclusion that the most convenient and labour-saving contrivance for the daily observation of the chromosphere would be to photograph daily the image of a ring-slit, which should be coincident with an image of the chromosphere itself.

The same idea has since occurred to another of us; we therefore beg leave to send in a joint communication to the Royal Society on the subject, showing the manner in which this kind of observation can be carried out, remarking that although the method still requires some instrumental details, which will make its working more perfect, images of the chromosphere, almost in its entirety, have already been seen on several days during the present month and the latter part of last month.

The image of the sun is focussed on a diaphragm, having a circular disk of brass (in the centre) of the same size as the sun's image, so that the sun's light is obstructed, and the chromospheric light is allowed to pass. The chromosphere is afterwards brought to a focus again at the position usually occupied by the slit of the spectroscope; and in the eye-piece is seen the chromosphere in circles corresponding to the "C" or other lines. A lens is used to reduce the size of the sun's image, and keep it of the same size as the diaphragm at different times of the year; other lenses are used in order to reduce the size of the annulus of light to about $\frac{1}{8}$ inch, so that the pencils of light from either side of the annulus may not be too divergent to pass through the prisms at the same time, and that the whole annulus may be seen at once. There are mechanical difficulties in producing a perfect annulus of the required size, so one $\frac{1}{2}$-inch diameter is used, and can be reduced virtually to any size at pleasure.

The proposed photographic arrangements are as follows:—

A large Steinheil spectroscope is used, its usual slit being replaced by the ring one.

A solar beam is thrown along the axis of the collimator by a heliostat, and the sun's image is focussed on the ring-slit by a 3$\frac{3}{4}$-inch object-glass, the solar image being made to fit the slit by a suitable lens.

By this method the image of the chromosphere received on the photographic plate can be obtained of a convenient size, as a telescope of any dimensions may be used for focussing the parallel beam which passes through the prisms on to the plate.

The size of the image of the chromosphere obtained by the method adopted will be seen from the accompanying photograph, taken when the ring-slit was illuminated with the vapours of copper and cadmium.

* A paper read before the Royal Society.

ON THE SUPPLY OF PIG-IRON FOR THE BESSEMER PROCESS.*

By W. BAKER, Associate of Royal School of Mines.

THE Bessemer process has exercised so important an influence upon the iron and steel manufactures of England, and is such a bold innovation upon the ordinary metallurgical processes, that I may fairly assume a short paper upon its present condition will not be inappropriate for the discussion of the Rotherham Literary and Scientific Society. The opportunity of bringing out our thoughts upon some special subjects with which each of us may be familiar is a peculiar advantage of such meetings as the present. Without pretending to be teachers, or to speak with an authority not to be questioned, we may at least give a direction to other minds, which may result in not only the confirmation and strengthening of our own ideas, but also in some determinate action.

The Bessemer process, as you know, consists in forcing jets of atmospheric air through molten pig-iron, whereby certain combustible elements which are found in pig-iron are burned. The fuel thus made use of in the iron itself developes an intense heat, and all who have witnessed a Bessemer "blow" will agree that it is one of the grandest sights of our manufacturing neighbourhood. According to Hunt's Mineral Statistics in 1869, there were 57 Bessemer converters, with an aggregate capacity of 248 tons. The last return for 1871 give 89 converters, with a potentiality of 446 tons. Taking 5 charges a day, or 30 charges a week, this gives us 669,000 tons per annum, against 372,000 tons in the year 1869. It will be readily conceived that this enormous increase has had its effect upon the supply of the raw material. Let me then place together the figures denoting the production of pig-iron for the same years. In 1869, pig-iron, 4,970,206 tons; 1871, ditto, 6,627,179 tons: an increase of 33 per cent. Now, the question arises, how much of this pig-iron is used actually, and how much can be used for the Bessemer process? The quotation in the market price lists of Bessemer pig disclose the fact that there is a special quality of iron

* A Paper read before the Rotherham Literary and Scientific Society.

suitable for this manufacture. In order to appreciate accurately this fact, I will dwell for a few moments upon the chemical reactions which take place in the conversion of pig-iron into Bessemer steel. Ordinary pig-iron may contain carbon, silicon, manganese, sulphur, and phosphorus; traces of other elements are sometimes found. For the Bessemer process, as well as for crucible cast-steel, the absence of sulphur and phosphorus is essential, or at most they may be present in extremely small quantities. Now, in the Bessemer converter, silicon appears to have the greatest affinity for the oxygen of the air. That is to say, silicon burns first and produces the heat due to its chemical combination with oxygen. The product of combustion is in its pure state a white solid, infusible, except under the oxyhydrogen blowpipe. In the converter it combines with some oxide of iron, and forms the slag or cinder, but often balls of white pumice-like silica, covered with a thin case of iron silicate, may be picked out of the cinder. These seem to have been formed by the rolling or splashing of the iron over the silica as it aggregated upon the surface of the molten metal. During the combustion of the silicon a more intimate combination takes place between the iron and the carbon. That is to say, the grey pig-iron, in which flakes of graphite exist, crystallised out in the mass of the soft iron, becomes changed into what is known as white iron. The latter is a variety of pig-iron, in which the carbon is chemically combined with the iron. Spiegeleisen is a typical example of this kind of iron. And now the combustion of the carbon begins, the product of combustion being in this case a gas, and the blue flame of carbonic oxide becomes whiter, and the roar of the furnace increases to its maximum. If we suppose the blast to be continued beyond the combustion of the carbon, what would take place? The iron would burn; and often a brown smoke, which issues from the mouth of the converter at the end of the process, announces that this is actually the case. The metal also would become unmanageable by frothing. It is usual, therefore, to stop the blast when the flame drops, and to add a known quantity of spiegeleisen. This iron contains generally about five per cent. of carbon and nine to thirteen per cent of manganese. With this addition the charge is tranquillised, metallic manganese imparts fluidity to the metal, and seems to protect the carbon from being burned. This I conclude from the fact that the Bessemer ingots themselves only contain traces of manganese, whilst the carbon ranges about 0·5 per cent.

A word about sulphur and phosphorus. It seems that both these elements refuse to give up their combination with iron at the solicitation of torrents of oxygen, as it exists in the air at the high temperature of the Bessemer converter, although both sulphide and phosphide of iron may be roasted at a low red heat, and these elements be nearly entirely removed from the oxide of iron which is left. The problem of eliminating phosphorus from metallic iron, leaving the iron in the metallic state, is one of the most pressing problems for solution by the metallurgical chemist. Most of the metals which are used in the arts are obtained first accompanied by certain impurities, and a general mode of refining them is to re-melt them with an oxidising flame, with or without the addition of fluxes. Copper is thus treated, so is lead, and it is instructive to compare the results with those obtained with iron. Copper, when melted under the circumstances mentioned, affords a slag, rich in fusible red oxide of copper, which is itself a flux, and melts readily with the oxides of other metals which may exist as impurities—only gold and silver of the ordinary metals will remain unoxidised. Now let us consider the refining of lead by a similar process. The same removal of impurities takes place, but besides gold and silver we have a certain proportion of copper which refuses to be oxidised, but rather concentrates in the metal if the process is continued. Plainly other chemical reactions must be sought for its removal, and I am pleased to observe that my own labours in this direction have been acknowledged by Dr. Percy in his third volume, which treats of lead. The successful solution of the problem in this case was afforded by the property of copper alloying with zinc, which alloy forms a less fusible mass, that can be removed from the surface of the metal in which it floats. If we treat iron in a similar manner, we get a slag or cinder composed of oxide of iron and silica. The process I am considering is the puddling process, which in the first stage may be looked upon as an analogous refining process. The silicon oxidises first, then the carbon, and if we would keep the decarburised iron fluid, it is quite possible that at the expense of some of it the comparatively small amount of sulphur and phosphorus which makes the grand distinction between good and bad pig-iron might yet be eliminated. We are, however, stopped in the process of refining, *i.e.*, the removal of impurities by oxidation—by the infusibility of iron deprived of carbon, and the charge is balled up and taken to the hammer for the production of wrought-iron. What I wish to point out here is that phosphorus in iron is analogous to the copper in lead; both resist oxidation to the last. The Bessemer process affords no help, the higher temperature at least might give the opportunity for the experiment. I mean that it would be worth while to see whether by continuing the blast at the expense of the iron as fuel a proportion of phosphorus to the extent of, say one-tenth per cent in the original pig-iron might not be eliminated. If this fail, we can at once and for ever give up the oxidation process for the removal of phosphorus. In puddling, it is true, a certain amount is removed, and the able paper on the Danks furnace, by my friend Mr. Snelus, of the Royal School of Mines, points to the probability, if not to the fact, that phosphorus in iron is oxidised by pure oxide of iron at the temperature of the puddling furnace. This certainly suggests the injection of metallic oxides with the blast, although the fatal infusibility of the decarburised iron is not favourable to the experiment. Mr. Isaac Lowthian Bell, whose labours as a scientific manufacturer cannot be too highly commended, has made some significant remarks on this subject. He says, "The limit to the production of Bessemer pig is the want of ores free from phosphorus." This may be correct, and so firm may be the grip that phosphorus holds on iron, that breaking up the bonds that bind them together may defy the skill of our scientific men; but it may be well to remember that the yearly make of iron from Cleveland stone alone contains about 30,000 tons of phosphorus, worth for agricultural purposes, were it in manure as phosphoric acid, above a quarter of a million, and that the money value difference between Cleveland and hematite iron is not short of four millions sterling, chiefly due to the presence of this £250,000 worth of phosphorus. The Pattinson process does not leave one part of silver in 100,000 of lead, the Bessemer converter robs iron of almost every contamination except phosphorus, but nine-tenths of this ingredient is expelled by the puddling furnace. It may be difficult, but let it not be supposed there would be any surprise excited in the minds of chemists if a simple and inexpensive process for separating iron and phosphorus were made known to-morrow, so that only one of the latter were found in 5,000 of the former. Analyses of the best Bessemer pigs give the following amounts of phosphorus, viz.:—0·014, 0·01, and 0·016 per cent. I select from analysis of Bessemer steel the following:—English make: 0·025, 0·033, 9·032, 0·026; mean, 0·029 per cent. of phosphorus. German make: 0·132, 0·134, 0·093, 0·041; mean, 0·10 per cent. of phosphorus. It will be noticed from the foregoing quotation that Cleveland pig-iron is contrasted with hematite iron. The distinction is this. Hematite iron produced from an ore of iron called hematite is sufficiently free from phosphorus to produce an iron suitable for the Bessemer process. Cleveland iron may contain from 0·5 to 1·5 per cent of this element.

The important question which justifies the title of my paper is this—What iron ore and how much iron is

there available to produce iron as good as this hematite iron? The total amount of iron ore produced in the United Kingdom is 16,334,888 tons. Of this large amount about one-eighth is hematite. The chief ores of iron, specimens of which are on the table, are as follows:—

Hematite, or red oxide of iron, in its purest state, contains 70 per cent of metallic iron. This occurs in the carboniferous limestone in Cumberland and North Lancashire. These deposits contain only traces of sulphur and phosphorus, or none at all. In 1871 2,232,068 tons were raised. Hematites are also found in Cornwall. The produce of this county is given at 9154 tons in Hunt's Mineral Statistics, but it is believed a much larger sum may be realised. Somersetshire afforded 2654 tons. Here our supply of magnificent ore comes to an end.

The next ore in importance is the brown iron ore called *Brown Hematite*. In composition this ore is oxide of iron combined with water. Some of the finest specimens are from the Forest of Dean, Gloucestershire. The Spanish and Portuguese ores seem to contain less combined water, and to hold a place between the ordinary brown hematites and the red ore.

Spathic or spathose iron ore is carbonate of iron. It is found in the Devonian series of rocks. This ore is renowned for producing the spiegeleisen in Saxony, which is imported for use in the Bessemer process. Somersetshire affords 27,556 tons, Northumberland and Durham 88,449 tons. I may observe here that spiegeleisen is another matter which presses itself upon the attention of the manufacturer of Bessemer metal. Until lately we were entirely dependent upon foreign countries, Germany or Sweden, for this beautiful pig-iron. But two years ago the Ebbw Vale Company succeeded in producing it. It is believed that the spathose ore is essential to its production, but I think as we have now interpreted in a scientific manner the old fashioned dogma about the nature of the ore giving a certain nature to the iron, it is quite possible to produce spiegeleisen from other ores than spathose. In this direction, if I may be allowed to speak critically, I think our local manufacturers have not shown sufficient enterprise.

Magnetic iron ore is a dense black ore. It is the real loadstone, but little developed in this country. The Swedes here have the advantage. It is nearly always very free from the objectionable impurities of sulphur and phosphorus, and if the find of coal in Sweden justifies the expectations of some of our speculators, good times are coming for the ironmasters in Sweden.

Micaceous iron ore is brought to this country from Elba, where it has been worked from the time of the Romans. This ore in composition is exactly that of red hematite. By far the larger proportion of iron ores in this country is the kind known as argillaceous carbonates—the clay iron ores of the coal measures. These we must dismiss from the category of ores fit for producing Bessemer pig. The proportion of phosphoric acid they contain varying from 0·3 to 0·7 per cent. The same may be said of the hydrated oxides of Lincolnshire, Northampton, and other places, as well as the argillaceous carbonates of the Cleveland district. The latter contains 1·07, 1·86, 1·17 per cent of phosphoric acid. Wellingborough ore contains 1·26 per cent of phosphoric acid. From Scotland we have little hope of ore suitable for Bessemer pig. Ireland may furnish a little. Even now Antrim affords a valuable aluminous ore which is said to be free from phosphorus. It will be seen, therefore, that until phosphorus can be eliminated from pig-iron, or until these ores which lie in such vast quantities at our feet can be smelted, so as to keep the phosphorus out of the iron, we must look to foreign ores for a supply of Bessemer pig. In Sweden, according to Forbes, there are 800 square miles producing magnetic iron ore, or specular oxides containing from 40 to 68 per cent of metallic iron, without any trace of sulphur and phosphorus, upon a convenient line of railway. It is estimated that ore of about 60 per cent could be delivered in England at 25s. per ton. The Spanish and Portuguese ores would no doubt produce a pure iron, and it remains to be seen how much the production of Bessemer pig will be increased by their use. That pure ores are greatly in demand may be judged from the fact that not only from Elba, but also from Algeria and Turkey iron ores are being sent into this country. Out of 16 million tons only two million of our iron ore is available for Bessemer pig, producing about 700,000 tons of Bessemer metal.

In conclusion, I must deprecate any severe criticism on my figures. The general facts, I think, I have placed fairly before you. It would have been impossible, without much greater labour and more time for inquiry, to get accurately the quantity of iron ore really used for producing Bessemer pig. At least I have drawn attention to the necessity of augmenting its source in a town where such a manufacture cannot but be regarded with unusual interest.

ON THE UTILISATION OF WASTE COAL.

By Dr. W. H. WAHL,
Secretary of the Franklin Institute.

The desirability of effecting the economic utilisation of the coal waste daily accumulating in the anthracite-mining regions is universally conceded. This waste, to take a moderate estimate, is not far from 50 per cent of the total production. The question has for years attracted the attention of inventors, of those interested in the mining and transportation of coal, and others, the result being the announcement and testing, from time to time, of a number of plans for satisfactorily attaining this object. It is, however, only within the past few years that the growing importance of the problem has attracted general public attention to the attempts at its realisation. With every expansion of the industries dependent upon coal for their existence, and therefore highly sensitive to the price of this commodity, the necessity for its successful solution will be enhanced. Thus far, however, it may be safely asserted, no process has been devised for this purpose which could be operated with a reasonable amount of success—a declaration which is verified by the fact that, after a trial of a few months, each has invariably been abandoned, though it is very probable that there are some among the hundred odd patents granted in this country alone under this heading which, under the stimulus that would be afforded their owners by any considerable increase in the marketable value of coal, would prove to be of practical value.

The difficulties in the way of effecting the utilisation of the anthracite waste are very great. They involve not only the question of economy of manufacture, which is absolutely controlled by the ruling price of coal at the mines, and which, from a financial standpoint, must necessarily stamp any such plan with a speculative character, but they reside also in the chemical and physical nature of the material.

The processes for the utilisation of the anthracite waste consist universally in the employment of a foreign material or materials, which shall serve the purpose of a cement to bind the loose particles of the waste together. The cements heretofore used have been both of mineral (incombustible) and of organic (combustible) character. In the majority of instances, as is usually the case with a field of invention just ripening into importance, the patentees of such processes display a characteristic ignorance of, or lofty indifference to, the conditions of the problem they profess to solve. The number and variety of substances which have been secured by inventors, either as cements, or to aid in the cementation or combustion, is well calculated to surprise one unfamiliar with the literature—if such an expression is allowable when applied to patent office records—of the subject. The several alkaline substances and their

silicates seem to have been held in special favour, since they repeat themselves, with some modifications, in several places. Lime, either alone, or with some subsequent chemical alteration into carbonate, sulphate, or sillicate is claimed; or plaster-of-paris or hydraulic cement are used directly. Clay must also be named. Among organic substances may be named pitch, coal-tar, resin, the Trinidad bitumens, asphalt, petroleum residues, dextrine, glue, Grahamite, &c., while as accessories, employed either to assist cementation or combustion, we have sawdust, chaff, flour, blood, cow-dung, starch, sand, saltpetre, and other substances too numerous to mention. Comparatively few of these processes have ever reached a public trial, as indeed few deserve it, and of those which have received attention, none have been more than indifferently successful, either from inherent deficiencies or from commercial reasons. We give a brief survey of some of the more important processes.

For a number of years the bituminous or semi-bituminous waste from the mines of Germany, France, and Belgium, has been to a considerable extent successfully utilised by mixing with it from 15 to 30 per cent of ordinary moist clay, and pressing this plastic mass into forms of any desired shape and size. The product thus obtained, though of inferior heating quality, still secures a ready market, owing to the high price of coal in the countries named, where it finds employment not only for household purposes but also for steam generation. Quite recently a similar process, by which the percentage of cementing clay is reduced to a minimum, has been brought out in America by a Belgian engineer familiar with the methods employed abroad. His plan, according to description, is to employ about 7 per cent of clay with the dust, and, after thoroughly mixing the materials, to bring the mixture into a pressing machine, where it is pressed into cylindrical forms of convenient size under considerable pressure. In order to protect the product from the disintegrating effects of rain or dampness, the inventor passes the lumps thus formed through a bath of resin dissolved in benzine, obtaining in this way thin hide of resin upon the surface of the lumps, which effectually serves the purpose of excluding the water.

This plan, from its simplicity, aided doubtless by the favourable opinion expressed of its merits by a committee of the Franklin Institute, has received the favourable consideration of the Lehigh Coal and Navigation Company. The adandoned works of a former unsuccessful company, which will be named hereafter, situated at Nesquehoning, Carbon County, Pa., have lately been secured by the Lehigh Company, for the purpose of giving the plan a thorough trial. The expensive machinery of their predecessors has been, or is now, in process of being modified to suit the present plan.

The same inventor has laboured zealously in this field for a number of years in the South, having for some time successfully manufactured at Nashville, Tenn., an artificial fuel by the same general process from the Southern bituminous coals, until certain business complications conspired to raise the price of the waste to so high a figure that the manufacture was abandoned.

The other plans (employing a mineral cement) as yet made public include those using an alkaline silicate (water-glass), either alone or in connection with a chloride of calcium or magnesium, or both, an hydraulic cement, plaster-of-Paris, &c. As far as the knowledge of the writer extends, none of these have yet passed through the ordeal of practice, and should this have occurred with any one of them it has simply resulted in a failure. All such attempts must prove unsuccessful, from the fact that either the combustible character of the coal waste is so considerably reduced by the mixture with it of from 10 to 20 per cent of non-combustible materials that the product can only be burned with difficulty, necessitating either constant attention or an artificial draught, or the cement employed fuses in the heat of the furnace, and, coating the cemented particles with a liquid glass, prevents the access of the air to it, preventing its combustion, and, finally, forms an objectionable clinker. For reasons to be specified below, the writer is of the opinion that no process employing a mineral cement will ever be more than indifferently successful, not excepting the clay process, of which so much is anticipated.

It is well known that coal of any description, and especially when in the finely-comminuted condition of dust, if exposed for some time to the combined action of air and moisture, gradually deteriorates in heating quality. This deterioration is produced, first, mechanically, by the slow admixture with it of dust and dirt carried by the winds; and, secondly, by a slow process of oxidation, analogous to the rusting of iron, which infallibly attends the exposure of any readily oxidisable substance to atmospheric influence. From both of these causes, the heating quality of the coal waste is slowly reduced (or its percentage of ash, to state the case in other words, is slowly increased), and this reduction in quality grows greater and greater with the time of its exposure. With bituminous lump, Varrentrapp estimates, from careful experiments, that the loss of heating power, from chemical causes alone, may even reach 25 per cent, and, for purposes of gas production, 45 per cent. With anthracite lump, the deterioration from this cause alone will be far less than with bituminous; but, from both the causes named, it must be evident that, with the anthracite in form of waste, the deterioration must in most cases be considerable enough to gravely influence the success of any plan having in view its manufacture into artificial fuel. By the employment of dust from freshly mined coal, or of a judicious mixture of the old waste with the new, the difficulty from this source may be partially overcome; but no scheme having for its object the utilisation on a large scale of the vast waste heaps of the anthracite region, can afford to be blind to the objection here named, since it is mainly from more or less deteriorated materials that the product to be utilised must be obtained.

Instead, therefore, of employing in the cementation of the waste a substance incombustible in itself, and which directly adds so much to the percentage of ash, and still further detracts from the heating quality of the waste, the path seems pointed out to inventors to seek about for some cementing material which, being itself combustible, will improve the heating qualities of the poor waste, and which must be free from certain collateral objectionable features incident to the problem. This fact seems to have been recognised long ago, as the list of combustible cements given previously would indicate. Whatever of historical record there has come to our knowledge with regard to their trials, however, is equally unfortunate with the mineral cement processes. In some of the European countries only, have the attempts to employ coal-tar, pitch, resin, and kindred substances to bind the loose particles of dust into a coherent mass been successful. In America it has several times been essayed to apply such a process to the utilisation of anthracite waste, but all have signally failed.

Several years ago a company was formed with this object in view, by whom the extensive works at Nesquehoning, Carbon County, Pa., referred to in a former portion of this article, were erected. They employed a mixture of waste anthracite with coal-tar; this, after the most thorough mixture which could be attained (with the aid of heat), was pressed into suitable forms, and subsequently transferred to an oven, in which it was subjected to a baking process. From the testimony of several engineers, superintendents, and others who used it, it appears that the product, in spite of the increment given to its heating quality by the addition of coal-tar, was but an inferior steam generator. Whether the only partial carbonisation of the tar by the baking process allowed the offensive coal-tar odour to be perceived or not, is a contingency not known to us; but it will readily be granted that, unless this carbonisation was complete, the introduction of the product for the household was im-

possible from the outset. It is most probable that the complicated character of the process, and the number of details requiring personal attention of workmen, aside from any consideration of the quality of the product, rendered the expense of its manufacture too great to permit of a successful competition with coal, and contributed mainly to the abandonment of the enterprise, which shortly followed. The failure of this, the best organised effort of any yet made to solve the problem of the waste heaps, would seem to indicate that, though similar plans have been, and are still, in successful operation in continental Europe, the cost of mining coal with us is yet too low to permit of the employment of a tarry or resinous cement to utilise our anthracite waste, even admitting that the fuel produced were of a satisfactory quality.

Of the other patented processes, but few are worthy of mention; the great majority read too much like kitchen recipes to deserve serious consideration, as a glance at the list will show.

It is of interest to note that the first reasonable process to utilise this material originated with Mr. Bessemer, in England, where the demand for some such process will be more than ever urgent, now that the English coals have lately risen so considerably in price. Mr. Bessemer's process is for the manufacture of an artificial fuel from bituminous waste, by employing a peculiarly constructed furnace, having a device somewhat like an endless chain-pump arranged horizontally, upon the successive sections of which the bituminous material, without foreign admixture, is led in from a hopper above, and is taken continuously from the furnace in a semi-caked plastic condition, and pressed in suitable forms or moulds, which are then ready for use. This plan has received considerable praise from scientific critics, of which it is indeed well worthy. It is now stated to be in successful operation in several large manufactories in England.

There remain, finally, to be mentioned several American processes for utilising coal waste by the use of Grahamite as a cement, which, as far as a judgment of their merits may be formed without the crucial test of practice, may ultimately prove to be satisfactory.

With us, however, for the present, this field of industry lies fallow for want of a cultivator.—*American Gas-Light Journal.*

OUTLINE OF A NEW EXPLANATION OF THE ACTION OF SUNLIGHT ON IODIDE OF SILVER.*

By Dr. J. EMERSON REYNOLDS,
Professor of Analytical Chemistry, and Keeper of the Mineral Department in the Royal Dublin Society.

WHITE light is known to exert a very marked influence upon a very large number of chemical substances; but certain salts of silver are known to be specially subject to the action of the more refrangible rays of the spectrum. When light acts for a considerable time on iodide, bromide, or chloride of silver, evident *decomposition* occurs; but when the action is stopped before any sensible effect has been produced, the silver salt can be shown to have suffered profound change, in consequence of which its relations to chemical agents are almost wholly altered. All who have practised the beautiful and interesting art-science of photography well know that advantage is taken of this subtle action of light in the familiar operation of "taking a negative." A layer of iodide of silver (or of iodide, bromide, and nitrate of silver) is exposed for a short time in a camera to an image formed by a lens; the silver layer, on removal, is apparently in the same condition after as before exposure; but when an acidulated solution of ferrous sulphate is applied, the parts which have been exposed to the action of light become dark, while the other portions of the film are unaffected. The iron solution is then said to "develop" the "latent image."

Notwithstanding numerous and well-directed investigations, the nature of this "latent image" remains a mystery. Quite recently, however, some remarkable experiments upon the action of light on chlorine have been published by Dr. Budde, of Bonn, which appear to me to give a very distinct clue to the *modus operandi* of light, more particularly on the iodide of silver.

I propose now to lay before the Society, in the first instance, a brief account of Dr. Budde's experiments, and his conclusions, and then to state the explanation of the nature and relations of the "latent image" on iodide of silver, which I have ventured to build upon the work of the German physicist.

It has been long well known that the blue and violet rays of solar light can determine the union of chlorine and hydrogen gases. The two bodies are freely miscible in the dark, without any chemical action taking place; but in diffused daylight the two gases slowly combine, and produce hydrochloric acid. If the mixture be exposed to direct sunlight, the same effect is obtained instantaneously, and a violent explosion is the consequence. The cause of this union under these conditions has not hitherto been traced out; but Dr. Budde has obtained the following remarkable evidence of the direct action of blue and violet light on pure chlorine gas:—

A quantity of chlorine gas was passed into a tube closed at one end, the gas being confined by a column of oil of vitriol saturated with chlorine, and the operation, of course, conducted as nearly as possible in the dark. A prismatic spectrum was formed in the usual way by means of a prism, and the several coloured rays, from red to ultra violet, allowed to fall in succession on the tube containing the chlorine, the latter being fixed in such a position that any alteration in volume which might take place during the experiment could be at once detected and estimated with the aid of an observing telescope, placed at a suitable distance. The red rays were allowed first to fall on the tube, but the effect produced was comparatively slight, as the maximum increase in the length of the gas column did not exceed the $\frac{1}{25}$th of an inch. The permanent expansion was greater in the more refrangible rays, until the maximum effect was obtained in the violet rays, the expansion being at least ten times greater than in the red rays, and this increase in volume was permanent. If the alteration of volume were caused by heat, the expansion should be temporary, and, further, the effect ought to be much greater in the red than in the violet rays. It is evident that the observed expansion *might* have been due to the decomposition of the sulphuric acid by the chlorine; but this source of error seems to have been fairly eliminated by substituting for the sulphuric acid saturated with chlorine the tetrachloride of carbon. The same result was obtained with the latter as with the former liquid.

If the experiments are to be fully trusted, chlorine is proved to have its volume permanently increased by exposure to the violet rays.

Dr. Budde concludes, from the results of his experiments, that sunlight, or rather the violet rays, act by decomposing the molecules of the chlorine, setting free the component atoms of which the so-called "molecule" is supposed to be built up. The atoms must occupy a greater space when separate than when combined forming the molecule, and are also in a peculiarly favourable condition for entering into combination with those of a new body. The rapid combination of chlorine and hydrogen under the influence of sunlight is, therefore, no longer difficult of explanation.

If Dr. Budde's conclusion be accepted for chlorine, it clearly follows that all the cases known to photographers, in which light brings about chemical change, may be explained simply and naturally on the hypothesis of the partial or complete separation of the atoms of which the molecule of a given compound may be built up. We here seem to break new ground, and to get a clue to a soun

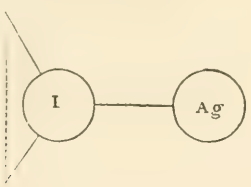
* Communicated by the Author, having been read before the Royal Dublin Society.

theory of the latent image, which shall serve to explain the phenomena relied on by the supporters respectively of the present vibratory and chemical hypotheses. I would now venture to suggest an explanation of the action of light on iodide of silver which, *prima facie*, seems to be complete.

It is well known that the atom of a chemical element is a sharply-defined relative quantity, but that the atoms of unlike matter often differ materially in the amount of chemical work they can perform; thus an atom of sulphur can represent 6 atoms of hydrogen in combination; nitrogen 5; carbon 4; boron 3; and oxygen 2 atoms of hydrogen; silver, on the contrary, only 1. But this so-called "equivalence" of an element is not absolutely fixed, for, in some of its compounds, nitrogen represents only 3 atoms of hydrogen—in ammonia, for instance—and in others, as in nitrous oxide, but 1. This variation is now commonly accounted for by supposing that pairs of points of attraction on the atom of a polyequivalent element disappear by neutralising each other, and thus lie hidden in certain forms of combination. If we represent the atom of nitrogen by a circle, its pentequivalent, triequivalent, and monequivalent conditions may be thus shown:—

In Nitric Acid. In Ammonia. In Nitrous Oxide.

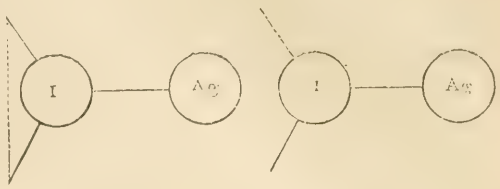
These points of attraction are now usually termed "bonds." Iodide of silver consists of 1 atom of silver and 1 of iodine, Now, the atom of silver is known to be equivalent to only 1 atom of hydrogen; but the study of organic and other iodine compounds teaches us that the atom of iodine is equivalent to 3 of hydrogen, though in most compounds only appearing to be equivalent to 1 hydrogen atom. Representing graphically the atoms of silver and of iodine respectively by equal circles, and the equivalence of each atom by lines projecting from the circumference as usual now in graphic formulæ, we may represent ordinary iodide of silver in the following way:—



Here one of the three "bonds" or centres of attraction of iodine is united with the single bond of silver, the other two neutralising each other, as indicated by the dotted line, and so remaining latent. Up to this point I have advanced nothing new; but it is necessary to recognise these preliminary matters in accounting for the action of light on iodide of silver.

Common experience leads us to the conclusion that in many cases the action of light chiefly consists in the severance of the union of unlike bodies held in combination by comparatively feeble affinity; and the highly interesting investigations of Dr. Budde would seem to go farther, and to prove that the same kind of action is inimical to the exercise of the still more feeble attractive force which tends to unite the atoms of like matter in molecules. We have only to extend the statement to the union of bonds in a single atom—as in the case of iodine—and we gain a perfectly intelligible conception of the nature of the influence exerted upon iodide of silver by light, and the cause of the well-known difference in chemical relations between the unexposed and exposed silver compound.

The two conditions may be graphically represented thus:—



Unexposed. After exposure.

After, as before, exposure the compound is iodide of silver; but two of the three attractive powers of the iodine are now free from each other's control, and ready to enter into new combinations. It is evident that change may now take place in either of two directions. First, the atom of iodide of silver may attract two additional atoms of silver or other analogous body to itself in so-called development; or, secondly, a complete separation of iodine from silver may arise, owing to the exercise of the superior power of the two free bonds of the former over the one attached to the silver atom. It appears by no means improbable that the first condition obtains in acid development with excess of silver, while in alkaline developement the action is more likely to be chiefly of the second kind.

Up to the point at which it is necessary to assume that light is capable of severing the union between the latent "bonds" of iodine, the theory is in harmony with the current of thought in chemistry. But it is not yet generally admitted that a "bond" can remain free or unsatisfied. The existence of such apparently anomalous compounds as nitric oxide and certain of the chlorine oxides has, however, led some chemists to think that certain "atomicities" in a compound may remain free, and ready to enter into new combinations on a favourable opportunity presenting itself. The experiments of Dr. Budde on chlorine strongly support such a view; and, further, when we carefully consider the action of chlorine on olefiant gas, under the influence of sunlight, I see no difficulty in supposing light actually to have the power of severing the union between the latent "bonds" of an atom. I venture to think that this could take place even more easily in some cases than could the separation between the atoms of the molecule of a simple body, or—the much more difficult case—of the disunion of the unlike atoms of a compound such as iodide of silver. If, then, the last, and as must be admitted, the least likely case to occur is that which we can, in several compounds, actually observe, we are clearly warranted in assuming the much easier, and, *a priori*, the more probable, change to take place also.

Let us now apply the theory stated above to the explanation of some of the facts of development. I shall take at present only the case of acid development—with iron, for example—in the presence of excess of silver in the solution flooding the film. The acid present prevents the immediate deposition of metal; but still the exercise of even a very slight attractive power is capable of separating the silver from the liquid. The existence and exercise of the surplus chemical energy of the iodine atom of the exposed iodide of silver is amply sufficient to account for the attraction to the exposed iodide only of the metal silver, and this without assuming that the iodide of silver itself suffers any decomposition; in fact, the process appears to consist in the formation of a *sub-iodide* of silver by *addition* of silver to the exposed iodide, not by *abstraction* of iodine, as might be supposed. If such a definite compound be produced in the manner indicated, its formula most probably is Ag_3I, for each of the three

"bonds" of the iodine is now engaged with an atom of silver.

If the film be now fully washed alter development, we have a layer of ordinary iodide of silver carrying an image formed of a sub-iodide of silver the constituents of which are held together by comparatively feeble force; but it is by no means improbable that the determination of silver to the exposed iodide in the first instance, in order that the sub-iodide may be formed, facilitates the deposition at the same time and on the same part of the film of metallic silver in addition; so that we are not to look upon the image as consisting only of the sub-iodide, but as carrying some free silver also.

When the conditions of development are such as to admit of very rapid deposition of this so-called "supplementary" silver, we should expect the precipitation to be determined by that species of sympathy so often observed in chemical processes, acting even outside the sphere of attraction of the exposed iodide of silver, and thus give rise to the well-known phenomena of solarisation and of fog. Assuming the image to be free from these defects, however, its subsequent intensification results from the well-known attraction of silver for silver on the point of deposition from solution.

Fixation by hyposulphite of sodium, or similar agent, in my view of the matter, consists in the decomposition of the above mentioned sub-iodide of silver, ordinary iodide of silver dissolving, and the excess of silver remaining, and forming the image in its final condition.

Such is the view which I venture to take of the action of light on iodide of silver, so far as the production of the "latent image" is concerned. The most reliable experiments have proved perfectly pure iodide of silver to be sensitive to light; it is, therefore unnecessary for me to extend this paper beyond reasonable limits by discussing the details of photographic processes, in which iodide of silver plays the chief part; but I should add that, so far as I am aware, there are no facts which the theory just proposed is not capable of simply explaining. Further, when the apparently conflicting statements of the physical and chemical schools of thinkers on this subject are reconciled on the physico-chemical theory which I have advanced, we may fairly regard the latter as a safe aid to investigation. I have only to add that the above sketch of a new theory of the "latent image" is to a large extent derived from several detailed articles which I published in the last volume of the *British Journal of Photography*.

ON THE

CHEMICAL PROCESSES OF THE LIVING PLANTS.

By A. EMMERLING

The chemical processes which obtain in plants are very imperfectly known to us. It is true that we are acquainted with a series of relations existing between some of the products of the materials of the vital activity of plants—for instance, that between chlorophyl and starch—and the manifold relations of some of the organic matters formed in plants to some of their mineral constituents, as for example the relation existing between potassa and starch, as proved by the researches of Nobbe. I must not also omit to notice the fact, that the more recent researches of organic chemistry bear upon and throw some light on the synthetical processes going on in plants; but, notwithstanding this, the efforts both of chemists and of phyto-physiologists have hitherto failed to state with certainty the progress and causes of the different reactions, decomposition, or formation going on in plants. The great difficulty and obstacle to this kind of research is that the chemical reactions of the plants are chiefly taking place in the plasma of the cells, which has to be considered as a mixture of many substances, most of them unknown, which are permanently subjected to changes by the influence of physical forces. We do not as yet possess the means of experimenting upon such a mixture, nor are we enabled to isolate therefrom single substances, nor is it at present possible to follow up all the phases of the various conversions of matter which take place, and hence we have been limited in our research to microscopical investigation of the processes going on in the protoplasma so far as these can be observed. Chemistry has taken another step in this field of research, and has tried to find out how far the growth of the plant depends on the presence of certain mineral matters, thus fixing the physiological value of the minerals to plants, as proved by Nobbe's researches. Although very valuable knowledge of the general requirements of plants in respect of mineral matters is thus obtained, we have not learnt the true chemical processes—the *modus quo*—how the various mineral matters act in the process of formation of the organic substances. In making experimental researches in this direction, it is necessary in the first place to discover proper methods, and I have adopted one which, so far as I know, is quite novel, and differs from other methods in that it tries to draw conclusions from facts already known, aided by experiments made beyond the interior of the plants, in order to ascertain what takes place in the interior. I considered that it might perhaps be possible to ascertain certain reactions beforehand, by relying upon certain initial facts of the agentia active in plants, and thus to learn deductively (*deductiv*) the further conversions or mutual reactions of matter that take place in them.

While engaged in extending the chemical facts required for my ultimate conclusions, I discovered and investigated some simple reactions, the results of which I am about to describe in the following part of my essay. In the first place, I considered the conversions which the mineral salts sucked up by the roots undergo in the interior of plants. That saline solution comes into contact with the acid juices produced by the plant, which juice always contains a certain proportion of free vegetable acids, viz., oxalic, tartaric, malic, &c. Considering these organic acids to be, at least in relation to the mineral salts, the main active principles of the juices contained in plants, I thought it best to investigate their action upon such of the mineral salts as are prominently active in the nutrition of plants.

Owing to the enormous extent of this field of research I had at the outset to limit my investigation to a few special points, and selected such reactions as appeared to me undoubtedly to take place within the interior of plants. It may be taken for granted that plants absorb nitrates from the soil, and also that oxalic acid is largely dispersed through them, and hence I investigated the action of oxalic acid upon the nitrates of lime, potassa, and soda. The experiments with lime salts are easily made. I used very dilute solutions, in order to imitate as much as possible what takes place in the plants themselves; I investigated the reactions between oxalic acid and nitrate of lime in all possible conditions; I determined the influence of time, of degree of concentration, of excess of either of the two salts, of the presence of foreign salts—in fact, I operated in all directions. I found that oxalic acid separates a portion of the lime in the shape of a crystalline oxalate, while nitric acid is set free. The quantity of lime thus precipitated depends entirely on the conditions under which the experiment is made; the greater the dilution of the fluids and the shorter the duration of the action, the smaller is the quantity separated; but even in very dilute solutions it is relatively very large, and when the duration of the experiment is sufficiently long, the precipitation is almost complete, viz., complete decomposition of the nitrate of lime with formation of oxalate. An instance of the progress of the reaction will prove this. With a degree of dilution corresponding to 1 equivalent = 28 of lime (in the shape of nitrate of lime) and 1 equivalent of oxalic acid in 200,000 c.c. of water, there was precipitated of the 28 of lime—

After 15	minutes time	13·2 or 47·1	per cent.
,, 18	hours ,,	20·8 ,, 74·2	,,
,, 70	,, ,,	22·4 ,, 80·0	,,
,, 168	,, ,,	22·8 ,, 81·4	,,

The formation of a precipitate only ceases when the liquid is highly diluted, because precipitation is then counteracted by the solubility of the oxalate of lime. I further found that the separation of oxalate of lime is increased as much by an excess of nitrate of lime as by an excess of oxalic acid, while the nitric acid acts as a solvent; I hence inferred—and found confirmed by experiment—that the solvent capability of the nitric acid is lessened by the addition of oxalic acid, so that, to a certain extent, the one acid counteracts the other.

As regards other and more exhaustive details, I shall have to refer my readers to my work on this subject, which is to be shortly published. The main result of my researches is therefore the following:—That, under all conditions, nitrate of lime and oxalic acid act upon each other in dilute solutions in such a manner that, while nitric acid is set free, oxalate of lime is precipitated; and since these substances occur also in the juices of plants it is clear that there the same reactions take place, and consequently the vegetable juices must of necessity contain free nitric acid. The oxalate of lime thus separated in the plants plays the part of a by-product, which is deposited in proper spaces, either cells or membranes; this fact I elucidated by microscopic research, because I found that the oxalate of lime precipitated from the dilute solutions I operated upon is, when viewed by the microscope, distinctly crystalline, while the size and mode of grouping together of the crystals seem to depend upon the dilution of the solution. The shape of the crystals just mentioned agrees exactly with that of the oxalate of lime most frequently in plants. They are monoklinœdrical prismas, belonging to the orthoclase shape, which have a great tendency to form twins, and are often united into crystalline agglomerations frequently met with in plants, and termed by botanists morning stars, on account of their peculiar shape.

I have not succeeded in producing raphides artificially, but I do not doubt that I may also obtain these by a proper arrangement of the conditions of the experiments. It is clear that the investigation of the decomposition of the potassic and sodic nitrates, supposing it to take place in an analogous manner, is far more difficult. Although it is a fact that, by the distillation of a mixture of nitrate of potassa and oxalic acid in the presence of a small quantity of water, fumes of nitric acid are given off, it would be quite erroneous to infer from this fact what might happen in very dilute solutions. I had therefore to devise a method which would not only admit of the detection of the reactions (double decomposition) in very dilute solutions, but this without the further addition of any chemical reagent, by which perhaps the conditions of the reaction might be altered. I found a method, although in a somewhat circuitous way, which answered my purpose, and has, moreover, the advantage of being applicable to the solution of the question of the mutual decomposition of salts—for instance, chloride of sodium and sulphate of magnesia, when in solution.

This method is based upon diffusion, and the principle may be elucidated in the following manner: Let us suppose that we have a solution of a salt, of which it is premised that it is not altered by the chemical action of the water, and that this solution (without the aid of an intermediate membrane) is allowed to diffuse in pure water, by pouring a layer of water very gently upon the saline solution, and leaving the vessel containing the liquid to stand quietly. After some time layers, varying in thickness, will be formed, each containing variable quantities of the salt; but the relation between the acid and basis will be everywhere the same, since the salt is not decomposed. Let us now suppose that, at the outset, a second substance has been added to the saline solution, which exerts a decomposing action upon the salt, then in that case the new compounds, one of which contains the base, the other the acid, of the salt, will have a different capability of diffusion, and consequently after some time the two constituents of the salt, while forming layers of different thickness, will not be present in the constant relation of the equivalents, but in a more variable proportion.

When the diffusion process is interrupted at the proper time, and the composition of the substances present in the different layers is determined by properly conducted chemical analysis, the results will prove whether a decomposition of the salt has taken place.

As regards the objections which might be raised against the applicability of this method, these I shall fully answer in my large work on the subject. By the use of this method, I have succeeded in giving a definite answer as regards the decomposition of the alkaline nitrates; but I will adduce here only one of the many experiments I have made:—1 litre of solution, which contained, upon 200,000 c.c., 1 equiv. of oxalic acid and 1 equiv. of nitrate of potassa, was placed in a tall cylindrical-shaped glass vessel, and upon that solution 1 litre of pure water was cautiously poured, and left to diffuse for a period of four weeks, after which I analysed two portions of the fluid, viz., an upper and lower layer. If no decomposition had taken place, I should have found in both layers the equivalent proportions of potassa and nitric acid; I, however, found in the upper layer an excess of nitric acid greater than that corresponding to the potassa equivalent, and in the lower a negative deviation; hence it might be inferred that decomposition had really taken place, and, as a control for the accuracy of the analysis, it was evident that the positive and negative difference of the upper and lower layers ought to possess equal value within the limits of faults of experiments. The difference amounted—

In the upper layer, to +0·20
In the lower layer, to −0·32

Taking into consideration the very small quantity of substance which, owing to the great degree of dilution of the liquid, could be operated upon, and also the difficulty of the estimation of nitric acid, and the constant influence of faults of experiments, by which the positive difference is lessened and the negative increased, I think a greater degree of agreement could hardly be expected than that just quoted; but, moreover, I made many similar experiments, and also corresponding ones with nitrate of soda. There can be, therefore, no doubt that the alkaline nitrates are in like manner decomposed, at least in part, by oxalic acid in very dilute solutions by the addition of oxalic acid.

It is true that I have not yet quantitatively estimated the relative quantity of nitric acid which is set free, but it must be observed that almost insuperable difficulties exist in such an estimation. It is probable that the alkaline nitrates are only partly decomposed, and by no means so completely as the nitrate of lime, because all the products of the reaction remain in solution, so that consequently, according to the well-known principles of the chemical influence of masses, the liquid comes to a state of equilibrium with which every reaction ceases.

By these researches we obtain some insight into a definite chemical process as it occurs in plants; we learn by what process the oxalate of lime so frequently met with in plants, and also the binoxalate of potassa, owe their origin, and we further find that the free nitric acid in the living plant is an active agent which plays a considerable part in the formation of the nitrogenous organic matters. Although it might be a pleasant field of further speculative discussion, I do not consider that we can enter more fully upon it so long as our knowledge of the first products of the reduction of carbonic acid are so scanty as at present. I think it very probable, however, that the nitric acid does not remain long unaltered, but is soon converted into either ammonia or hydroxylamine by the powerful reducing agency of the plants, while these last-named products in nascent state react upon the unequally nascent products of the reduction of carbonic acid, and thus together lead to the formation of organic nitrogenous compounds.—*Ber. d. Deutsch. Chem. Gesells.*

CORRESPONDENCE.

A GENERAL INDEX TO THE VOLUMES OF THE "CHEMICAL NEWS."

To the Editor of the Chemical News.

Sir,—I have just received the copious index to the last volume of the Chemical News, and am thereby reminded to ask whether you have any intention of giving your readers, sooner or later, a general index to the whole of the published volumes. I am sure that most, if not all, of your subscribers would, like myself, gladly pay any reasonable sum for so extremely useful a compilation.—I am, &c.,

John Attfield.

17, Bloomsbury Square, W.C.,
January 7, 1873.

[The twenty-six indices would make about 150 pages. The cost of printing would be very considerable, and we could not anticipate more than a limited number of purchasers. When the subject was mooted some time ago we only had a dozen or two replies. If, however, a sufficient number will guarantee the expense it shall be commenced at once.—*Ed. C. N.*]

THE ESTIMATION OF SULPHUR IN PYRITES.

To the Editor of the Chemical News.

Sir,—I cannot see that Mr. Holland's paper is a very valuable contribution to our knowledge on the estimation of sulphur in pyrites. He gives us a new method of fusion which I certainly think is not an improvement upon the fusion in porcelain crucibles in the absence of platinum. Again, anyone having had much experience with the estimation of sulphur in pyrites would never resort to the incorrect method of fusion. I have found, after many years' experience, that a sulphur estimated by the fusion process is always half per cent or rather more than by the acid way. I have assayed ores by fusion which have been done by some of our well-known analysts, and have always found that I have obtained a higher result; it surprises me how Mr. Holland has so cleverly overcome the difficulty, for I see that his fusion and acid processes agree. I know there is a troublesome way of purifying the barium sulphate, but from reading the paper I should not think Mr. Holland has employed it. I would prefer the fusion process in platinum crucibles to all others, if it gave correct results; and therefore Mr. Holland would be conferring a great boon upon chemists if he would describe the method by which he gets such good results.—I am, &c.,

Experience.

FLUORESENCE AND THE VIOLET END OF A PROJECTED SPECTRUM.

To the Editor of the Chemical News.

Sir,—In reading over my article in your journal of Dec. 6, which has just arrived, it strikes me that some may be puzzled by a statement on page 273 unless a further explanation is made.

It is well known that the bisulphide of carbon will only transmit rays of the spectrum as high as about 17° of the Bunsen scale, or a little above the line H′, and it might therefore be asked how invisible lines could be shown on a fluorescent screen with bisulphide of carbon prisms. The fact is that even with a powerful electric light, so feeble is the illuminating power of the violet rays that nothing is visible on an ordinary screen, when a spectrum some 10 feet long is thrown much above 10 of the scale; while thallene, being strongly excited by rays even as low as 9 or F, turns the *practically invisible* violet lines into *brilliant* green ones. It would have been more strict to have said "above the upper end of the spectrum visible on the screen, in place of "above the violet end of the spectrum;" for though this seems to be the violet end, and is usually so called by lecturers, it is not identical with what is strictly so named in other connections.

Thus the lines shown in the lecture referred to, were the lines in that part of the violet not visible otherwise under the other conditions of the experiment, and not the extra violet lines.

With glass prisms higher lines can be shown; and with two fine quartz prisms and a lens of the same substance, which we have in our collections, I have projected all the lines of the strictly actinic or invisible spectra of the metals used, but on account of the smaller dispersion of these substances, the experiment is much less effective than that made with bisulphide of carbon prisms as described.—I am, &c.,

Henry Morton.

Stevens Institute of Technology, Hoboken, New Jersey,
Dec. 30, 1872.

MISCELLANEOUS.

Metropolitan Gas Supply.—The reports of the chief gas examiner, just presented to the Corporation of London and Metropolitan Board of Works, show the average quality and purity of the gas supplied during the past quarter by the three companies under his supervision, as follows:—

	Illuminating power. Candles.	Sulphur. Grs. per 100 ft.	Ammonia. Grs. per 100 ft
Chartered Company:—			
Beckton	17·00	11·52	0·69
Bow	17·31	6·70	0·50
Blackfriars ..	17·31	16·10	0·12
Westminster ..	16·76	21·55	0·42
Pimlico (cannel)	24·25	10·38	0·42
Imperial Company:—			
Fulham	17·23	33·19	0·69
St. Pancras ..	15·85	32·04	0·05
Haggerstone ..	16·07	27·32	0·02
South Metropolitan	16·24	33·72	0·00

Short interruptions to the testings happened at some of the stations during the stokers' strike, and a deficiency of illuminating power was reported on a few occasions, but these have been certified as having occurred from "unavoidable cause." On all other occasions the quality of the gas has been above the statutory requirements.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, January 6, 1873.

This number contains the following original papers and memoirs relating to chemistry:—

Nitrification of Garden-Mould.—J. B. J. D. Boussingault.—This exhaustive monograph treats on the formation of nitre in the nitre-beds, and in arable and garden soils.

Some Combinations in which Phosphorus Appears to be Present in an Allotropic State, similar to that of the so-called Red Phosphorus.—A. Gautier.—After referring to a suboxide of

phosphorus, P_4O, discovered in 1837 by Le Verrier, the author points out that there are several compounds of phosphorus, the real composition of which is not at present well known some of them being amorphous. The main portion of the essay is devoted to the description of a compound formed by the action of protochloride of phosphorus upon phosphorous acid when these substances are heated in sealed tubes to a temperature of about 170°; the result in this instance is the formation of amorphous phosphorus according to the formula—

$$3PCl_3 + 2PH_3O_3 = 4P + 3P_2H_4O_7 + 9HCl.$$

When these substances are only heated to 79° the reaction is different, and there is formed a compound P_4HO according to the following formula:—

$$11PCl_3 + 27PH_3O_3 = 4P_4HO + 11P_2H_4O_7 + 33HCl.$$

The body alluded to is yellow-coloured, amorphous, unaltered by exposure to dry air, insoluble in water, alcohol, ether, benzin, chloroform, oil of turpentine, glycerine, acetic acid, protochloride of phosphorus, and protochloride of antimony. The substance is very stable, and bears heating in a current of dry carbonic acid to 250°. At 265° some phosphuretted hydrogen is given off, and at 350° to 360° phosphorus distils over. When heated in contact with air, this body (P_4HO) burns slowly; mixed with chlorate of potassa it detonates by the application of a smart blow. Dilute acids do not act upon it, but ordinary nitric acid gives rise to violent reaction. Water at 170° decomposes the compound with formation of pure phosphuretted hydrogen PH_3, and phosphorous as well as hypo-phosphorous acids. Alkalies decompose P_4HO, which unites with ammonia. The author concludes his paper with some observations on Le Verrier's suboxide of phosphorus, which he thinks may be identical with the compound obtained by him (see *Annales de Chimie et de Physique*, 2nd series, vol. lxv., p. [illegible]).

Estimation of Ammonia in Illuminating Gas.—A. Houzeau.—The detailed description of a volumetric process, in which dilute sulphuric acid of known strength, and also an ammonia solution of definite strength, are applied; the gas is passed from the meter through the acid. According to the author the gas at Rouen was found to contain on an average 0·1042 grm. of ammonia in 100 litres of gas, while the gas in Paris only contains 0·009 grm. of ammonia in the same bulk.

There are also several original papers relating to mathematico-physical and natural history sciences.

Bulletin de l'Académie Royale des Sciences, des Lettres et de Beaux Arts de Belgique, No. 11, 1872.

Contains no papers relating to chemistry.

Journal für Gasbeleuchtung und Wasserversorgung, No. 23, 1872.

The contents of this number relate only to gas- and water-works engineering.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, December 12, 1872.

Bleaching Cotton, Flax, and Rags Intended for Paper-Making, &c., by Means of Ozone.—M. David.—The anthor ozonises air by passing it over a mixture of permanganate of potassa, peroxide of manganese, and sulphuric acid contained in large carboys. He then conveys the ozonised air into a brick tank, which contains the materials to be bleached. After some some hours' contact with the ozonised air they are all perfectly bleached and clean.

Although not belonging to chemistry, we call attention to the following memoir:—

Bascule Balances and Weighing Instruments.—L. Paupier.—Illustrated by several woodcuts. This essay describes weighing-machines largely used abroad but almost unknown in this country. These machines are in every respect superior to the ordinary balances in use, especially for heavy weights.

Steam-Boiler Anti-Crustation Composition.—Bonatte and Co.—The constituents of this material are not specified, but it is stated to be very effectual, safe, and anti-corrosive.

Iron Ore from Andorra.—H. Flobert.—It appears that the mineral resources of the country alluded to (the most ancient Republic of Europe) are beginning to attract attention. In addition to excellent qualities of fine marble, copper and lead ores, and useful mineral waters, there is abundance of excellent iron ore free from sulphur and phosphorus, and having, according to the author's analysis, the following percentical composition:—No. 1—Water, 7·24; peroxide of iron, 87·215; siliceous matter insoluble in acids, 3·103; manganese, 0·35; other matters (not specified) soluble in acids, 2·092; total, 100·00; percentage of metallic iron, 61·50. No. 2—Water, 8·60; peroxide of iron, 74·13; insoluble in acid, 10·60; soluble in acid (not specified further), 6·495; manganese, 0·165: total, 100·0; metallic iron, per cent, 51·9.

Trade in Esparto Grass (Lygæum Spartum) of Algeria.—Ch. Mène.—This paper contains statistical and other interesting information on this subject.

Bulletin de la Société Chimique de Paris, December 15, 1872.

From the *proces-verbaux* of the meetings of this Society, published in this number, we quote the following:—

Preparation of Di-Isopropyl.—R. D. Silva.—The author observes that Dr. Schorlemmer's statement concerning the inactivity of sodium upon the iodide of isopropyl is not quite correct, since the author found that decomposition ensues at from 120° to 130°. With the evolution of gas (C_3H_6 and C_3H_8) simultaneously there is obtained a hydrocarbon, C_9H_{20}, boiling at 130°; constitutional formula—

$$\begin{array}{l} CH_2 - C_3H_7 \\ | \\ CH - C_3H_7 \\ | \\ CH_3 \end{array}$$

This investigation was instituted with the view of obtaining an alcohol, $C_9H_{18}OH$, from the chloride $C_9H_{19}Cl$ obtained by Dr. Schorlemmer by means of di-isopropyl, but this research is not yet finished.

Lactate of Lime.—A. Petit.—When a solution of this salt is treated with phosphoric acid so as to form a decimal solution (*solution audixieme*) of lacto-phosphate of lime, there is formed a liquid which, when cold, is quite clear and free from any precipitate; but when hot, a precipitate is formed, which almost re-dissolves on cooling.

This number further contains the following original essays and papers:—

Two Pentachlorides of Benzine.—E. Jungfleisch.—This lengthy essay is chiefly written to explain the objections made by Dr. Ladenburg, and published in a German scientific periodical, against the author's researches on this subject, which will be shortly published *in extenso*. It appears, however, that there is a difference of the action of pure dry chlorine upon benzine, and of that gas in wet state, which apparently has escaped Dr. Ladenburg's notice.

Chlorhydrate of Narceine.—A. Petit.—This paper treats chiefly on the solubility of narceine, its chlorhydrates and their mode of preparation. Narceine is very soluble in caustic potassa solution (0·15 thereof dissolves 1 grm. of the alkaloid), and in caustic ammonia, which leaves the narceine, after evaporation, in crystalline state. Narceine is soluble in 769 parts of water; narceine + HCl in 277 parts of water; narceine + 2HCl in 150 parts; narceine + 3HCl in 130; narceine + 4HIC in 50.

On the Hydrates of the Monobasic Fatty Acids.—E. Grimaux.—This exhaustive monograph, elucidated by a large number of complex formulæ, is not well suited for abstraction.

Polytechnisches Journal von Dr. E. M. Dingler, first number for December, 1872.

New Method of Preparation of Caustic Soda.—W. Helbig.—The main gist of this paper relates to the oxidation of some sulphur compounds, present in the crude materials (the concentrated lye), by means of a forced current of air passed into the concentrated liquor instead of the use of saltpetre. From the account here given, it appears that while the last-named salt cannot be quite dispensed with the quantity has been greatly decreased.

Estimation of the Quantity of Juice Present in Beet-roots.—F. Jicinsky.—This essay, illustrated by woodcuts and elucidated by several tables, contains a detailed account of the best methods of estimating the quantity as well as the saccharine value of the juice of beet-roots.

Priew's Steam-Clearcing Method.—Dr. Dingler.—This paper, also illustrated by engravings, contains the account of a newly-devised method of clearcing sugar by means of low-pressure steam and air mixed, instead of the use of a pure concentrated sugar solution. The process is carried on in connection with centrifugal machines.

Application of Steam for the Purpose of Extinguishing Fires.—Dr. H. Weidenbusch.—This essay treats exhaustively on the application of steam for the purpose of extinguishing fires. The author quotes several well known instances in which steam, superior in every respect to water, has been successfully used to arrest the spread of, and rapidly extinguish fires.

Gas-Tight Impermeable and Indestructible Corks.—F. Ruschhaupt.—The process here described consists in soaking the corks in pure molten paraffin, whereby, according to the author, the corks are rendered perfectly impermeable to gases and a great many liquids (all those which do not act upon nor dissolve paraffin), while the corks are rendered to some extent indestructible.

The American Journal of Science and Arts, December, 1872.

In addition to a series of original papers relating to other physica sciences, this number contains the following original papers bearing upon chemistry:—

Note upon Aventurine Orthoclase Found at Ogden Mine, Sparta Township, Sussex Co., N.J.—Prof. Leeds.—After giving a geognostico-mineralogical description of this mineral, the author quotes the following chemical analysis per cent:—Silica, 64·81; alumina, 19·02; ferric oxide, 0·23; lime, 1·26; magnesia, 0·59; potassa, 14·30; loss by ignition, 0·26.

On Soil Analyses and their Utility.—E. W. Hilgard.—This paper has already appeared in full.

On a Crystal of Andalusite from Delaware Co., Pa.—E. S. Dana.—Illustrated with woodcuts.

Journal für Praktische Chemie, No. 16, 1872.

This number contains the following original papers:—

Contribution to Our Knowledge of Diabase.—R. Senfter.—This exhaustive monograph is an appendix to T. Petersen's researches on green stones (see CHEMICAL NEWS, vol. xxvi, p. 288), and is elucidated by a series of tables exhibiting the results of analyses of a large number of minerals. The main results of the author's investiga-

tion may be summarised as follows:—The diabases contain regularly a triklinic (*triklinen*) alkali felspar, which has to be considered as oligoclase; while in addition to that often a lime felspar is found, which is probably labradorite. The second main constituent of diabase is genuine augite, in which the quantity of lime is about equal to that of the magnesia and protoxide of iron. Diabase also contains protoxide of iron-magnesia-chlorite (*Eisenoxydul-magnesia-chlorite*), the composition of which agrees with the usual formula assigned to chlorite. Titanium-containing magnetic iron and apatite never fail to be present in diabase; while calcite also is a regular constituent of diabase, although it is only present in small quantity. To the genuine diabase, which frequently contains, or is mixed with other minerals, belongs many kinds of rocks usual designated hyperites.

Electrolysis of Itaconic Acid.—G. Aarland.—This essay is divided into the following sections:—Introduction, containing a review of electrolysis as applied to organic substances; preparation of itaconic and mesaconic acids; behaviour of citraconic, itaconic, and mesaconic acids with chloride of iron; detailed account of the electrolytic experiments, elucidated by a large number of complex formulæ.

Behaviour of Carbonate of Magnesia towards Gypsum in the Presence of a Solution of Common Salt.—Dr. E. Fleischer.—This paper contains an account of a series of researches made by the author with the view of ascertaining the mutual reactions which take place when the carbonates of lime, magnesia, baryta, and the sulphate of lime are boiled together in water, either pure, or containing common salt. Notwithstanding the comparatively great insolubility of some of these substances, double decompositions take place in some cases amounting to more than 30 per cent.

On Coal-Tar and Coal Tar-Pitch (Asphalte).—Dr. E. A. Behrens.—The first part of an exhaustive monograph; this portion is divided into the following sections:—Coal-tar in general; coal-tar pitch.

Pharmaceutische Zeitschrift für Russland, No. 19, 1872.

In addition to several papers relating to pharmaceutical science' this number contains an interesting memoir:—

On Fish Poison.—Dr. A. Casselmann.—It appears that in several parts of the Russian empire cases of poisoning caused by the eating of salt fish, chiefly *Accipenser Beluga*, a kind of sturgeon, are by no means rare. Chemically, the author cannot find the cause of the origin of this poison, which curiously fails to affect cats and dogs.

No. 20, 1872.

This number contains no original papers relating to chemistry.

No. 21, 1872.

This number contains, in addition to papers relating to pharmaceutical science, the following memoir:—

Alkaloids of the Papaveraceæ.—H. Ludwig.—The catalogically arranged enumeration of the alkaloids met with in opium (product of the *Papaver Somniferus*) and those met with in the *Papaver Rhœas*.

No. 22, 1872.

The papers published in this number only relate to pharmaceutical science.

Bulletin de la l'Academie Imperiale des Sciences de St. Petersbourg, vol. xviii., No. 1, September, 1872.

The original chemical memoirs in this number have been already noticed (see CHEMICAL NEWS, vol. xxvi., p. 265).

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2181. J. Robey, Manchester, "Improvements in the manufacture of a substitute for animal charcoal, to be used for purifying sewage and various other substances."—Petition recorded July 20, 1872.

2667. E. Ross, St. Mary Axe, London, "An improved method of utilising and giving additional value to the products of the coffee-bush."—Petition recorded September 9, 1872.

3270. C. Rave, Cureghem-lez-Bruxelles, Belgium, "The manufacture from mahogany and other woods of a colouring matter similar to cashoo."—Petition recorded October 18, 1872.

3306. H. Page, Market Buildings, Mincing Lane, London, "Improvements in the manufacture of paper-pulp, or half-stuff."—Petition recorded November 16, 1872.

3585. F. M. Lyte, Asnières, France, "Improved process of treating and purifying crude phosphoric acid, and in the production of soluble phosphates; also for the manufacture of phosphorus, and the treatment of certain residues resulting therefrom, and phosphate of alumina."—A communication from Henri Storck, Edouard Hentsch, Auguste Hentsch, Andre Lutscher, and Frederic Grininger, Asnières, France.—Petition recorded November 28, 1872.

3609. T. Richardson, J. W. Richardson, and A. Spencer, West Hartlepool, Durham, "Improvements in refining or puddling iron and steel."—Petition recorded November 30, 1872.

3741. W. A. Lyttle, Hammersmith, Middlesex, "Improvements in candles."—Petition recorded December 10, 1872.

3780. P. Love, Bedford, "Improvements in machinery for excavating and treating substances excavated, especially applicable for the conversion of bog-moss or fen into peat for fuel."—Petitions recorded December 13, 1872.

3799. S. Hickson, King's Road, Bedford Row, Middlesex, "Improvements in preserving meat."—Petition recorded December 14, 1872.

3813. A. M. Clarke, Chancery Lane, Middlesex, "An improvement in artificial fuel."—A communication from E. F. Loiseau, Pennsylvania, United States of America."—Petition recorded December 16, 1872.

3821. J. L. F. Target, Portsdow Road, Middlesex, "Improved means or apparatus for receiving human excreta, and for distributing, deodorising, or disinfecting powder over the same.

3829. J. F. Lackersteen, Lombard Court, City of London, "Improvements in the manufacture of hydrogen gas."

3830. H. Page, Mincing Lane, London, "Improvements in the manufacture of paper-pulp or half-stuff."—Petitions recorded December 17, 1872.

3851. S. Holker, Lumb, Lancaster, "Improvements applicable to the treatment of straw, esparto, wood, and similar substances used in the manufacture of paper."—Petition recorded December 18, 1872.

3853. F. B. Houghton, Southwark, Surrey, "Improved method of, or process for, treating spent hops for the manufacture of paper-pulp."—Petition recorded December 19, 1872.

3882. W. W. Fereday, Dover Road, Surrey, "Improvements in treating human excreta, and in apparatus for working the excreta and converting the same into a dry and highly-concentrated manure."—Petition recorded December 21, 1872.

3889. J. Senior, New Ross, Wexford, Ireland, "An improvement in the process of unhairing and preparing skins or hides to be employed for making or dressing into leather of any kind."—Petition recorded December 23, 1872.

3913. L. A. Badin, New Ormond Street, Middlesex, "Improvements in closets and apparatus for collecting and disinfecting fœcal matters, and converting the same into manure or human guano."

INVENTIONS PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF COMPLETE SPECIFICATIONS.

3843. G. Haseltine, Southampton Buildings, London, "An improved method of, and apparatus for, rendering and drying animal matter, deodorising noxious gases, and treating blood to utilise it for agricultural and similar purposes."—Petition recorded December 18, 1872.

3968. G. T. Bousfield, Sutton, Surrey, "Improvements in the manufacture of steel, and in apparatus employed for this purpose."—A communication from T. R. Scowden, Cincinnati, U.S.A.—Petition recorded December 31, 1872.

NOTICES TO PROCEED.

2456. E. T. Hughes, Chancery Lane, London, "Improvements in the manufacture of loaf sugar, and in the machinery or apparatus employed therein."—Petition recorded August 17, 1872.

2491. C. F. Sebille, Paris, "Improvements in the composition known as 'schisto-asphaltic and bituminous beton,' and novel applications thereof, together with improved machinery or apparatus in connection therewith."—Petition recorded August 22, 1872.

2528. J. F. Parker and A. Wade, Birmingham, Improvements in the manufacture from coal and petroleum of hydrocarbon gas, or gas for illuminating and heating."—Petition recorded August 26, 1872.

2529. H. A. Dufrené, Paris, "An improved mode of preserving fruit."—A communication from F. Sacc, Neuchatel, Switzerland.

2538. H. Y. D. Scott, Major-General, C.B., Ealing, Middlesex, "Improvements in the treatment of sewage and in the preparation of manures therefrom."—Petitions recorded August 26, 1872.

2805. W. Rath, Plattenburg, Westphalia, "Improvements in annealing and removing of oxide or scale from iron and steel wire and other articles of iron and steel."—Petition recorded September 23, 1872.

3502. T. A. Howland and C. G. McKnight, both of Rhode Island, U.S.A., now of Southampton Buildings, London, "Improvements in the manufacture of gas and in apparatus therefor."—Petition recorded November 22, 1872.

3696. T. Green, Phœnix Chemical Works, Ouseburn, Newcastle-on-Tyne, "Improvements in the treatment of bones and other articles, and in apparatus for the same."—Petition recorded December 6, 1872.

3763. R. S. Casson, Brierley Hill, Staffordshire, "Improvements in puddling furnaces, heating furnaces, and other reverberatory furnaces used in the manufacture of iron and steel."—A communication from P. A. Dormoy, Troyes, France.—Petition recorded December 11, 1872.

3799. S. Hickson, King's Road, Bedford Row, Middlesex, "Improvements in preserving meat."—Petition recorded December 14, 1872.

PATENTS SEALED.

1984. W. E. Gedge, Strand, Middlesex, "A new or improved process of preparing phosphorus.—A communication from A. Peluche, Paris, France.—Dated July 1, 1872.

2004. W. Thwaites, Brixton, Surrey, and E. Fondeville and G. Bertin, Kentish Town, Middlesex, "Improved composition or admixture for preserving walls from dampness, and for other purposes."—Dated July 2, 1872.

2036. E. J. L. Caillot, Barcelona, Spain, "Improvements in the manufacture of lighting and heating gas, and in apparatus and burners connected therewith."—Dated July 5, 1872.

2044. W. Weldon, Putney, Surrey, "Improvements relating to the utilization of waste chlorine."—Dated July 6, 1872.

2093. J. R. Casbay, Newman Street, Oxford Street, Middlesex, "An improved compound to be applied to the surfaces of wood or metal to preserve the same from corrosion or decay."—Dated July 11, 1872.

2262. T. R. Crampton, Westminster, "Improvements in the manufacture of gas and fuel, and in apparatus to be used for this purpose."—Dated July 29, 1872.

2576. G. Spencer, Cannon Street, London, "Improvements in the purification of coal-gas used for illuminating purposes and for mechanical purposes, and in apparatus therefor."—A communication from E. White, New York, U.S.A.—Dated August 30, 1872.

2614. B. W. Gerland, Macclesfield, Cheshire, "Improvements in the manufacture of phosphoric acid, phosphatic manures, alkaline and other phosphates."—A communication from H. and E. Albert, Biebrich, Germany."—Dated September 3, 1872.

2766. W. E. Newton, Chancery Lane, Middlesex, "Improvements in the preparation of explosive compounds."—A communication from J. H. Norrbin and J. Ohlsson, Stockholm, Sweden.—Dated September 18, 1872.

3309. H. Deacon, Widnes, Lancashire, "Improvements in the manufacture of bleaching-liquor."—Dated November 7, 1872.

NOTES AND QUERIES.

Analysis of Sugars.—(Reply to "Subscriber.")—Consult Dr. Stammer's work, the title of which we have lately given in full.

Acid in Crude Sugar.—(Reply to J. M. Merrick.)—There may be some lactic and formic acids, but the acetic acid is the principal one, and is due to the previous formation of alcohol. Consult the work mentioned above.

MEETINGS FOR THE WEEK.

MONDAY, Jan. 20th—Medical, 8.
TUESDAY, 21st.—Civil Engineers, 8.
—— Royal Institution, 3. Prof. Rutherford, "On Forces and Motions of the Body."
—— Anthropological, 8
—— Zoological, 8½.
WEDNESDAY, 22nd.—Society of Arts, 8.
—— Geological, 8.
THURSDAY, 23rd.—Royal, 8½
—— Royal Institution, 3. Dr. Debus, F.R.S., "On Oxidation."
—— Royal Society Club, 6.
FRIDAY, 24th.—Royal Institution, 9. Prof. Birks, "Analogies of Physical and Moral Science.
SATURDAY, 25th.—Royal Institution, 3. Edward A. Freeman, D.C.L., "On Comparative Politics."

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THE CHEMICAL NEWS.

VOL. XXVII. No. 687.

ON THE UNION OF AMMONIA NITRATE WITH AMMONIA.*

By EDWARD DIVERS, M.D.

AMMONIA nitrate deliquesces in ammonia gas at ordinary temperatures and pressures, forming a solution of the salt in liquefied ammonia. To prepare the product it is only requisite to pass dry ammonia gas into a flask containing the dry nitrate, but the condensation proceeds more rapidly if the flask is surrounded with ice.

The liquid obtained varies in composition according to the temperature and pressure. At a temperature of 23°, and the pressure of the atmosphere, it consists of about 4 parts of nitrate to 1 of ammonia by weight; but under greater pressure, or at lower temperatures, much more ammonia can be condensed by the nitrate. At 0° and the pressure of the atmosphere, two parts of nitrate can condense one part of ammonia. The liquid boils when heated, and, when nearly saturated with nitrate, deposits crystals of it when cooled—just like an aqueous solution. It can also, like an aqueous solution, be heated above its boiling-point without boiling, and become supersaturated with the salt without crystallising. When poured out into an open vessel, it becomes almost instantly gelatinous in appearance—may, indeed, become so as it falls in a stream from the flask containing it. This effect is due to evaporation of ammonia and solidification of nitrate at the surface of the liquid; on breaking the crust of nitrate, the compound flows out as liquid as ever. It is not caustic to the dry skin. During its decomposition cold is manifested, and during its formation heat is evolved, but not to a great extent, because the heat given out by the liquefaction of the ammonia is nearly all used up in the liquefaction of the nitrate.

The specific gravity of the liquid varies, of course, with its composition. When it consists of two of nitrate to one of ammonia, it has a specific gravity of 1072·5, while it has a specific gravity of nearly 1200 when it consists of four of nitrate to one of ammonia. Its specific gravity can be calculated from its composition, by taking for the purpose 1524·5 as the specific gravity of the nitrate, and 671 as that of the ammonia. The number 1524·5 is much less than that expressing the actual density of the nitrate in the solid state, but does not differ very much from its apparent specific gravity in aqueous solution.

In its rate of expansion by heat, the liquid resembles others that exist as such at ordinary temperatures, rather than those that, like ammonia itself, are only retained as such by great pressure. Its expansivity increases with the quantity of ammonia present.

The volume of a mixture of the liquid with water is much less than the sum of the volumes of the liquid and the water, and yet a marked absorption of heat occurs during the admixture. The same thing happens when a concentrated aqueous solution of the nitrate is poured into water, as was first pointed out by Gay-Lussac. Other examples of this remarkable phenomenon have been observed by different chemists, and it has received various explanations. F. Mohr considers that heat is used up in the depression of the freezing-point of the water caused by the salt. As this depression of the freezing-point is probably attended by an increase in the latent heat of the water, his explanation appears to be the correct one. Thomsen finds the specific heat of the mixture to be less than the mean of the specific heats of its components.

Its action upon a great number of substances, principally inorganic, has been tried, and found to be for the most part like that of ammonia (in the absence of water) and ammonia nitrate conjoined. The nitrate appears to undergo double decomposition with most salts, and the ammonia to unite with nearly all of them, including those of magnesium, aluminium, iron, and manganese. The ammoniated chromium salts possess considerable stability. The ammoniated mercuric iodide is resolved by washing into ammonia and mercuric iodide again. The ammoniated compounds which do not dissolve in the liquid are very bulky, as observed by Gore in his experiments upon ammonia liquefied by pressure. Nitrates, chlorides, iodides, bromides are either soluble as Gore has found them to be in ammonia alone, or else are decomposed into soluble chlorides, &c., of ammonium, and insoluble ammoniated compounds of the metals. Sulphates, oxalates, chromates, and arsenites are insoluble, and phosphates are nearly so. Phosphoric and chromic anhydrides do not act upon the liquid with the energy that might be expected, but combine with the ammonia. Iodine dissolves freely, as it does in ammonia alone (Gore). Bromine generates nitrogen. Lead salts, including sulphate, chloride, iodide, and oxide, are freely soluble as ammoniated compounds. Platinous chloride dissolves freely as tetra-ammonio-platinous chloride. Potassium salts are very sparingly soluble. Alkalies and their carbonates decompose the nitrate; so do litharge, lime, and baryta. Calomel is converted into metallic mercury, and a soluble ammoniated mercuric compound. Potassium, sodium, zinc, and cadmium dissolve without liberating gas, by reducing the nitrate to nitrite; potassium inflaming, magnesium slowly dissolves, liberating a little hydrogen, reducing the nitrate and becoming partly converted into Beetz's black suboxide of magnesium. Methyl iodide is decomposed; butyric ether and chloroform are sparingly soluble without decomposition. Ether is insoluble, but by its contact causes the liquid to break up into its two constituents.

It is a good electrolyte, ammonia and hydrogen appearing at the negative electrode, and nitrogen and ammonia nitrate at the positive electrode. Its decomposition may be thus represented:—

$$\overbrace{H_3 \text{ and } 3NH_3}^{-} \mid \overbrace{N \text{ and } 3NO_3HNH_3}^{+} (=3NO_3+4NH_3).$$

Positive electrodes of silver, lead, copper, zinc, and magnesium are dissolved by the liquid as (ammoniated) nitrates. A positive electrode of mercury is converted into a compound almost insoluble in the liquid. When the electrode is acted upon, the generation of nitrogen does not take place.

* Abstract of a Paper read before the Royal Society.

ON CŒRULIGNON, A BY-PRODUCT OF THE INDUSTRIAL MANUFACTURE OF WOOD-VINEGAR.

By C. LIEBERMANN.

CŒRULIGNON is the name given to a new substance, of a blue colour, first observed during the industrial purification of crude pyroligneous acid in the works of Herr Th. Lettenmayer, at Königsbronn. I obtained a small sample of cœrulignon through the kindness of Privy Councillor Dr. V. Fehling and Professor V. Meyer, who had observed that it dissolved in strong sulphuric acid, and was of a beautiful blue colour similar to that of the flowers of *Carduus Benedictus*. A larger sample having been forwarded to me by Herr Lettenmayer, I have been able to make an investigation of this substance, and to communicate the following details concerning its discovery and preparation:—

The crude acetate of lime, obtained by the saturation of the raw pyroligneous acid, is dried, in order to prepare wood-spirit (crude methyl-alcohol), and then, having been mixed with a sufficient quantity of hydrochloric acid, it is placed in stills, in order to separate the acetic acid. When this is mixed with a small quantity of a solution of bichromate of potassa, and left quietly standing for a while at the ordinary temperature, a blue-coloured film is gradually formed on the surface of the liquid, which, becoming more dense, forms gradually a violet-coloured sediment; this is the raw cœrulignon, which may be further purified by lixiviation with water. Viewed by the microscope, this substance is found to consist of small needle-shaped crystals, soluble in concentrated sulphuric acid, exhibiting a blue-coloured solution, from which, however, the substance cannot again be separated unaltered.

On being heated with caustic potassa solution, cœrulignon shows the following reactions:—At first the liquid assumes a green colour, which rapidly turns yellow; when it is evaporated and concentrated to the fusion-point of the potassa, the brown-coloured mass, when treated with water, yields a very deep violet-coloured solution, which, however, is not permanent, but akin to the alkaline solutions of logwood. The cœrulignon has hereby become converted into other compounds, which are with great difficulty isolated. The fact that cœrulignon is quite insoluble in all other solvents, and is, besides, neither sublimable nor distillable without decomposition by the aid of heat, made the purification of this substance rather difficult; it had been found still to contain a good deal of ash after the lixiviation process. I discovered, however, that phenol dissolves cœrulignon at the ordinary temperature, and produces a red-coloured solution, which, on being filtered, yields, by the addition of either alcohol or ether, a deep steel-blue coloured precipitate, consisting of very small needle-shaped crystals; and these crystals, after having been washed with either alcohol or ether, constitute pure cœrulignon, the chemical composition of which may be expressed by either of the two following formulæ: $-C_{15}H_{14}O_6$ or $C_{30}H_{30}O_{12}$.

Cœrulignon is a very stable compound, and nearly insoluble in all menstrua; it is not a dye, nor a pigment, and does not impart colour to fabrics either by itself or by the aid of mordants. It combines with glacial acetic acid (the anhydride), forming a colourless crystalline product; strong nitric acid converts it into oxalic acid. When cœrulignon is heated with hydriodic acid and amorphous phosphorus to 160°, the result is the formation of the pigment referred to when the potassa reaction was spoken of. This pigment dissolves in ether, producing a colourless solution, which, on being evaporated *in vacuo*, yields an amorphous mass. When this is treated with alkaline solutions, it exhibits a beautiful colouration, but one which rapidly fades.

As cœrulignon is insoluble in wood-vinegar, and not volatile, it cannot be contained as such in the distilled wood-vinegar, but must be formed after the distillation from some other substance whereon the addition of bichromate of potassa has some influence. The application of that substance to the crude vinegar is for the purpose of purifying the crude liquid, the result being the formation of a copious and brown-coloured precipitate. I have found that, in several different instances, this precipitate always contains cœrulignon, which may be detected by the following process:—From 30 to 40 c.c. of the crude wood-vinegar is mixed with one-fourth of its bulk of a cold saturated solution of bichromate of potassa. The ensuing precipitate is first washed with water, next boiled with alcohol, and then with glacial acetic acid, then dried, and lastly treated with phenol; thus a red-coloured solution is produced, which, having been filtered, yields, by the addition of alcohol, a deep steel-blue precipitate—and this is cœrulignon.

This experiment proves that the reason why the body just named has hitherto been entirely overlooked by wood-vinegar makers is, that the cœrulignon is separated with several other substances, while the quantity of the material from which it is generated in the crude wood-vinegar is not small. It has not yet been ascertained whether all kinds of wood yield this compound. The wood used at Königsbronn is beech and birch, and by the dry distillation these both yield cœrulignon; but I have also found this body in crude wood-vinegars, the origin of which, as regards the wood employed, is unknown to me.

Since I obtained the cœrulignon quite free from ash, thus proving that it is not a coloured lake, the idea has struck me that it is perhaps formed by the oxidising action of the bichromate of potassa upon some substance present in the crude wood-vinegar, and I therefore tried to recover that body by the reduction of the cœrulignon. This I effected by the aid of tin and hydrochloric acid, which, on being boiled with cœrulignon, yield a colourless solution. On the addition of chloride of iron, this solution becomes for a moment of a deep red colour, similar to that produced in the chloride by sulphocyanide of potassium, and next a beautiful violet-coloured crystalline precipitate of cœrulignon. The compound thus formed, which I term hydrocœrulignon, when prepared in the manner just described, is with difficulty obtained in a pure state, but is also formed in a somewhat complex reaction when potassa is made to act upon cœrulignon. When that body and caustic potassa are heated with some water, a yellow-coloured pasty mass is first formed, which is next treated with hydrochloric acid and washed with water; this resinous mass, when treated with boiling alcohol, yields a crystalline colourless compound.

The reduction of cœrulignon is rapidly effected by means of yellow-coloured sulphuret of ammonium, whereby heat is developed; and, after the addition of hydrochloric acid and washing, a compound soluble in alcohol is obtained, which, on evaporation of that liquid, again yields the colourless crystalline body.

An aqueous solution of sulphurous acid also reduces cœrulignon, at 170°, to beautifully crystallised hydrocœrulignon; sodium amalgam is not as good a reducing agent. Hydrocœrulignon is hardly soluble in water, but is soluble in alcohol and acetic acid; it fuses at 190°, and distils over undecomposed when cautiously heated, the distillate yielding large-sized colourless crystals. With the vapours of acetic acid, hydrocœrulignon is somewhat volatile. When treated with oxidising agents, viz., bichromate of potassa, chloride of iron, chlorine and bromine water, nitric acid, copper and silver salts, cœrulignon is again obtained, and with chloride of iron it may be titrated; for, as long as any cœrulignon remains, ferrocyanide of potassium does not yield prussian-blue. The formula of hydrocœrulignon is $C_{15}H_{16}O_6$; it combines with acetic anhydride and chloride of benzoyl, yielding compounds corresponding to those formed under the same conditions with cœrulignon. When ignited with zinc-dust, hydrocœrulignon yields a hydrocarbon in large quantities. Concentrated sulphuric acid dissolves hydrocœrulignon, exhibiting an orange-coloured solution, which, on being heated, becomes magenta-red. Hydrocœrulignon failed to act as white indigo does in the vat for dyeing. There can be no doubt that hydrocœrulignon is the substance present in crude wood-vinegar, which yields the cœrulignon; but in the industrial preparation of wood-vinegar by the decomposition of the acetate of lime with hydrochloric acid, only a small quantity of cœrulignon comes over with the distillate, since the larger part remains in the still. I found, from an experiment made, that, from a solution of hydrocœrulignon in acetic acid, the former is only distilled over in a somewhat larger quantity when a portion of the retort is overheated; but, since the product of the oxidation of hydrocœrulignon (viz., cœrulignon) is then largely formed, that substance may even be obtained on a large scale by the hundredweight.

The analysis and behaviour (with reagents) of the two above-mentioned bodies indicate that hydrocœrulignon,

$C_{15}H_{16}O_6$, is a compound belonging to the higher phenols. The green hydrochinon, $C_{30}H_{30}O_{12}$, or chinon, $C_{15}H_{14}O_6$, is the cœrulignon; but these formulæ are as yet only empirical, and derived from the percentically-obtained figures by analysis. When cœrulignon is left standing with concentrated sulphuric acid, heat is set free, and it yields a compound which, when treated with alcohol, is a brownish red crystalline isatine, a body which has the same composition as cœrulignon, but is not readily converted into hydrocœrulignon. I have every reason to believe that the precise formulæ of these interesting compounds will soon be found; and I also think there can be no doubt that, in the bodies under consideration, we have to do with a less far-fetched product of decomposition of woody fibre, or of the incrustrating matter of wood, than in the products of dry distillation of wood now known. —*Ber. d. Deutsch. Chem. Gesells.*

REMARKS UPON C. UNGER'S TREATISE ON THE CONSTITUTION OF ULTRAMARINE.

By W. MORGAN.

In *Berichte der Deutschen Chemischen Gesellschaft*, vol. v., p. 893, C. Unger has communicated his views respecting the constitution of ultramarine, and states as follows:—

"The chemical nature of ultramarine, notwithstanding the numerous investigations which have been made thereon, is by no means enlightened, and the general acceptation that it contains aluminium sulphide, or sodium sulphide, or sodium polythionate, is still very doubtful when one sees that ultramarine is not decomposed by fused potassium chlorate, and that it withstands decompositlon for some time when heated with alkalies and nitrates. It is true that ultramarine, when heated with soda-lime, yields at most but a trace of ammonia; *but if one heats it with fused microcosmic salt, or with an alkali acid sulphate, a considerable quantity of nitrogen will be liberated.*"

He then proceeds further, and concludes his treatise with a series of formulæ which would explain the whole series of reactions which take place in the manufacture of ultramarine:—

$$\underbrace{AlO_3 + SiO_2 + 4Na_2S_2O_3 + 2Na_2CO_3}_{\text{Contents of mixture in furnace.}} =$$

$$\underbrace{AlSO_2 + SiSO + 2Na_2S}_{\text{Sulphobasic oxysulphuret.}} + \underbrace{4Na_2SO_4 + 2CO_2}_{\text{Which are removed.}}.$$

Thereto 2O from the air =

$$\underbrace{AlSiS_2O_5}_{\text{Ultramarinogen.}} + \underbrace{2Na_2S}_{\text{Which are removed.}}.$$

Thereto S in form of vapour =

$$\underbrace{AlSiS_2O_3}_{\text{Oxysulphuret.}} + \underbrace{SO_2}_{\text{Which is removed.}}.$$

Thereto 2N from the air =

$$\underbrace{AlSiS_2O_3N_2}_{\text{Ultramarine.}}.$$

In blue ultramarine Unger found 5·5 per cent of nitrogen. Although ultramarine has been the subject of numerous investigations and analyses during the last forty years, I have not been able to find any mention made as to the presence of nitrogen therein, and none of the analyses show a deficit of 5·5 per cent, which should be the case according to the quantity of nitrogen found by C. Unger. I became induced, under the guidance of Professor Will, to test the truth of his statements by the following experiments, the blue ultramarine used being previously washed out thoroughly and dried at 100° C.:—

(1). 3 to 4 grms. thereof were mixed with 12 grms. of *pure* acid sulphate of potassium, and the mixture brought into a combustion-tube, the ends of which were bent upwards—the one end being connected with a carbonic acid apparatus, the other end attached to a tube passing into a mercurial trough. After expelling the air as completely as possible by dry carbonic acid gas, the connection therewith was cut off, the tube gently heated, and finally raised to redness, the evolved gases were passed into a cylinder filled partly with mercury, partly with caustic potash, after the manner of nitrogen determinations; the total quantity of unabsorbable gas being 2 to 3 c.c., the which re-ignited a glowing chip when plunged into it, and showed the presence of oxygen mixed with air.

(2). In precisely the same manner the experiments were conducted with *pure* fused microcosmic salt, and again about 2 to 3 c.c. of unabsorbable gas were received, which proved to be air.

(3). 2 to 3 grms. of ultramarine, mixed with soda-lime, and heated in a combustion-tube connected with a Will and Varrentrapp's apparatus containing hydrochloric acid, into which the evolved gases were passed. At the close of the experiment the contents of the bulbs were tested for ammonia by adding chloride of platinum and alcohol, and not the least trace of a precipitate produced; and by Nessler's test but a trace of precipitate was yielded.

This last experiment was repeated with soda-lime alone, and the results showed that it evolved a trace of ammonia when heated.

These results speak for themselves, and conclusively prove that nitrogen is not a constituent of ultramarine, and that the formula $AlSiS_2O_3N_2$, put forward by C. Unger, is a false one.

Giessen, January, 1873.

ADULTERATION ACT, 1872.

THE following suggestions on the Adulteration Act, 1872, have been circulated by the Vestry of St. Pancras:—

So soon as the necessary officers have been appointed by the vestry to execute the provisions of the Act, it will be necessary that the action of such officers be governed by regulations to be fixed by the vestry.

These regulations should be divided into two parts:—

1.—Those relating to private purchasers who may wish articles analysed.

2.—Those for the inspector under the Act, who should submit articles for analysis in his capacity as a public officer only.

REGULATIONS FOR PURCHASERS GENERALLY.

The Act of 1872, clause 9, provides for the payment of a fee for analysis of not less than 2s. 6d., nor more than 10s. 6d. As the object of the vestry should be to have the Act carried out efficiently, rather than to receive large fees; and as it would be difficult for the ratepayers generally to understand a scale of fees, whether governed by the value of the analysis or otherwise, there should be an uniform fee of 2s. 6d. charged to all purchasers of articles not intended for re-sale, and a fee of 10s. 6d. to all purchasers of articles intended to be re-sold.

The fee should be paid to the inspector, who should give a printed receipt for the amount, and all fees should be accounted for by him to the vestry clerk; and the inspector should not, under penalty of dismissal, be allowed to receive any fee or reward other than that fixed by the vestry.

When a sample is brought to the inspector by a private purchaser, such purchaser should make a declaration before the inspector, that the article brought for analysis has been purchased at a place within the parish; and the name of the vendor and place of purchase should be stated in the declaration. The sample should be divided into

three, and each portion enclosed and sealed by the inspector, in the presence of the purchaser; and the purchaser should also be allowed to affix his seal or other mark to each packet; but no name or other distinguishing mark should be placed on the sample, except the name of the article, and labels descriptive of any admixture. The inspector should at the time he receives the samples, enter in a form, provided for the purpose, the date, the name, and address of the person bringing the sample, the name and address of the vendor, a distinguishing number of the sample, and other particulars. One portion sealed, but *not* bearing the distinguishing number, should be returned to the purchaser, the second sealed and numbered should be retained by the inspector, and the third should be divided into two, each portion sealed, marked, and numbered (with a number corresponding to that on the second sample), in the presence of the analyst—one portion left with the analyst, and the other retained by the inspector, in order to prove the identity of the article.

The inspector should not, except as provided for in section 3 of the Act of 1860, give to the analyst the name of the person bringing an article for analysis, or the name of the vendor of such article.

The analyst should, in his certificate of the result of his analysis, refer to the particular sample analysed by number and description only, and the certificate should be so worded as that it cannot be applied to any other sample, or used in any other way for the purposes of advertisement.

The inspector should not be allowed to alter or interfere in any way with the certificate, so as to identify such certificate with the vendor of the article, or with any other person, and should not be allowed to give any form of certificate himself.

As to Articles Purchased by the Inspector.

There should be a systematic scheme of sampling.

The inspector should be only partially under the control of the analyst, *i.e.*, he should at the request of the analyst obtain samples of any given article from the dealers in such article, in any one ward or district of the parish; but in every other respect he should act only under the regulations of the vestry.

When required by the analyst to obtain samples of any article, he must obtain such samples, as far as possible, from all vendors of the article in the ward or district. He must, in the presence of the vendor, divide his purchase into three, and enclose each sample, and the inspector and the vendor should seal the same; but no name or other distinguishing mark should, *in the presence of the vendor*, be placed upon a sample, except the name of the article, and labels descriptive of any admixture. The inspector should leave one portion with the vendor, and should, immediately after leaving the vendor, attach a distinguishing number to the two samples in his possession, retain one himself, under seal, and sub-divide the other into two, in the presence of the analyst, retaining one sub-divided portion, and leaving the other with the analyst, and upon such portion the certificate of the analyst should be given.

The certificate to be given under the same conditions as above-mentioned in regard to a private purchaser.

When the analyst shall be of opinion that the result of an analysis of any article is such as to warrant the vestry instituting proceedings against the vendor, he should make a special report at once to that effect to the vestry, using only the number of the sample; and the vestry should thereupon, and without the name of the vendor being made known, resolve whether proceedings should be taken against such vendor.

The analyst should be required to provide a laboratory at his own expense, and all assistance and things necessary for the purposes of analysis. He should be paid by fixed salary, and not be allowed to receive any fees whatever, except fees for attendance in a court of justice on proceedings being taken by the vestry.

The forms, containing the names and other particulars with reference to the numbered samples, and such numbered samples should be kept in the custody of the inspector until the analysis is complete, and the certificate of the analyst given; and they should be then handed over to the custody of the vestry clerk, to be kept by him in the vestry's strong room; and no other officer or other person should have access to such forms, or to the sealed samples, except as ordered by a Court of Law upon any proceedings against the vendor of adulterated articles, or by the vestry.

Printed by order of the General Purposes Committee.

Thos. Eccleston Gibb,
Vestry Clerk.

UTILISATION OF COAL WASTE.

By E. F. LOISEAU.

An article on the "Utilisation of Waste Coal," very ably written, appeared in the October number of the *American Exchange and Review*, and was reproduced by almost all the American scientific papers. The anonymous author of this article has evidently studied the subject carefully, and his objections to the different processes which have been tried to solidify coal dust are serious ones; but his knowledge of the facts seems to be limited entirely to what has been tried in America, and he seems to possess only some general information about what has been done abroad.

Alluding to the manufacture of artificial fuel in Europe, the author of the article referred to says that, "for a number of years, the bituminous or semi-bituminous waste from the mines of Germany, France, and Belgium has been to a considerable extent successfully utilised, by mixing with it from 15 to 30 per cent of ordinary moist clay, and pressing this plastic mass into forms of any desired shape and size. The product, thus obtained, though of inferior heating quality, still secures a ready market, owing to the high price of the coal in the countries named, where it finds employment, not only for household purposes, but also for steam generation."

Not only is the dust of bituminous and semi-bituminous coal consolidated with clay in Europe; but in Belgium, at the mines of Baulet, Auvelais, Ham-sur-Sambre and Tamines-sur-Sambre, the dust of a very dry coal, called stone coal, similar to anthracite, is also manufactured into solid lumps by a clay mixture. In France, in the department of Izère, at La Sable, Vizille, Arroux, where pure vitreous and specular anthracites, resembling those of Pennsylvania, are mined, the same process is applied. It is also applied in South Wales. It is not the high price of the coal, which secures to the artificial fuel, thus made, a ready market—it is its lasting qualities, its regular size, its being free from slate, sulphur, and other impurities, and giving no smoke. The slack coal in Belgium is not worthless as it is here; it is used for baking bricks, tiles, &c., and its price is only 30 per cent below that of coal. The artificial fuel costs as much as the ordinary coal and sometimes more; still it is preferred to the ordinary coal.

The manufacture of bituminous and semi-bituminous waste into solid lumps by the use of coal-tar as a cement, has long ago been abandoned in Europe. Fluid pitch is still used at La Charotte, France, but all the other factories of France, England, Germany, and Belgium are using either clay or the residuum of coal-tar, submitted to boiling until it is freed of from 50 to 60 per cent of its volatile matters; it then constitutes dry pitch. This pitch is ground, mixed with the coal dust, in the proportion of about 8 per cent, conveyed by a propeller screw through a heated cylinder which softens the pitch, into a mixer, and from this mixer to a press, to be moulded into lumps of suitable sizes.

Although the lumps are submitted to almost complete

carbonisation, this coal is unfit for domestic purposes. It answers well for steamers, locomotives, &c., and it does not disintegrate, while burning, as the coal cokes before the pitch is consumed; but when pitch is mixed with anthracite coal dust, and pressed into lumps, these lumps disintegrate in the fire and the particles of coal fall through the grate without being consumed.

Some manufacturers, and among them, John Christie and Thomas Harper, in England, and Euryale Dehaynin, in France, thought that by more mechanical combination of materials, they could obtain results equivalent to a chemical change in the ingredients themselves; thus, that by the mixtures of anthracite and bituminous slack, a fuel could be obtained corresponding in its properties to steam, or semi-bituminous, coal; or that by mixing a good with a very poor coal, a fuel of a fair average quality could be obtained. Nothing could be further from the truth, for mere mechanical combination can in no way alter the nature of the several ingredients used. In the fuel thus made with a mixture of coals, each particle burned in the precise manner, and gave the results due to peculiar seam from which it was taken, whilst the pitch used for combining the small particles of coal gave out, in like manner, the flame, heat, or smoke due to its combustion under similar circumstances when not forming part of a block of artificial fuel.

The process of manufacturing artificial fuel from bituminous or semi-bituminous coal dust, by cementing the particles with pitch, would be as successful in this country as it is in Europe, if the price of the coal were higher than it is to-day; at the actual low price, it would not be a remunerative business. The same difficulty would exist in the application of the process to anthracite waste, even if a perfect product could be made.

Having described the process of Bessemer, in England, for consolidating bituminous coal dust without any cement, by heating the dust to a semi-caked plastic condition and pressing it afterwards in suitable moulds, the author of the article says that "this plan has received considerable praise from scientific critics, of which it is indeed well worthy. It is now stated to be in successful operation in several large manufactories in England."

Scientific critics have praised the process, it is true, but the practical application of it has been a failure. Although Bessemer's process has been considerably improved by Evrard and Baroulier in France, the expensive machinery required for its application and the defects of the fuel produced, which had a great heating power, but could not bear transportation, were sufficient causes for the abandonment of the enterprise. There does not exist, to-day, on the Continent, a single establishment where the manufacture of artificial fuel from coal waste, without cement, is carried on.

Although the writer of the article objects strongly to the use of mineral cements, he seems to think that several American processes for utilising coal waste by the use of grahamite as a cement, may ultimately prove successful.

Grahamite is an asphaltic mineral found in West Virginia; it may be classed with the albertite of New Brunswick and the bitumen of Trinidad. Like these, it expands when submitted to elevated temperatures, and it emits while burning the same unpleasant odour and smoke which made the use of coal-tar pitch as a cement so objectionable in a fuel prepared for domestic use. Any kind of asphalt would answer as well as pitch to manufacture from bituminous coal dust an artificial fuel for manufacturing purposes, if the low price of the coal were not, as it is now, an insuperable difficulty. Applied to anthracite slack, to manufacture an artificial fuel for the same purpose, asphalt will not answer, on account of its tendency to expansion, and for household purposes it will not answer better than the pitch, on account of the smell and smoke. There remains the long-tested and cheaper process of cementing the coal dust with clay.

The first experiment in the manufacture of what is termed "artificial fuel" appears to have been made about the year 1594, when Sir Hugh Platt attempted to introduce into England, for use in common fire-places, a mixture of coal and clay, which he states to have been according to the manner of "Lukeland in Germany." He also used other mixtures, such as small coal with sawdust, tanner's bark, held together with loam or with cow-dung. These are set forth in a work published in 1603, and entitled "A New, Cheap, and Delicate Fire of Coal-Balls," by H. Platt.

No further experiments appear to have been made in this direction for nearly two centuries, when on Dec. 16, 1799, John Frederic Chabannes obtained an English patent for separating the large coal from the small coal, by passing the latter through sieves or gratings, made of wood or metal, and then consolidating the small coal by mixing it with clay, cow-dung, tar, pitch, &c., to be mixed together and ground with a wheel in water, in a wooden vessel. This mixture he afterwards placed in pits, provided with drains for the water to run off, and then, when almost dry, moulded the mass into cakes of a considerable size.

Since 1799, clay, conjointly with various resinous cements, has been used and patented in European countries by a number of so-called inventors. Among the most prominent were Levy, Stafford, Oram, Goodwin, Drouet, De la Chabeaussiere, Geary, Mohum, Stirling, Dominick, Holcombe, Smith, Hollands, Whitaker, and others. The clay was added to the mixture in order to counterbalance, by its tendency to contract when heated, the tendency of the resinous materials to expand. The resinous materials were added to the clay to make the fuel manufactured burn better and to render it impervious to moisture. The admixture of resinous materials with the small coal and the clay spoiled the fuel by the bad odour and smoke which it made while burning, and at the same time increased considerably the cost of manufacturing solid coal from slack.

While the inventors were trying to find some kind of cement which would hold the particles of coal firmly together until entirely consumed, without emitting smoke or odour, the people in the mining regions of England, France, Germany, and Belgium, feeling the need of a cheap and lasting fuel, were buying the small coal at the collieries, and adding to it from 30 to 40 per cent of clay, with sufficient water to moisten the mixture, worked it into a pasty mass with shovels, and by trampling upon it with wooden shoes. (In some parts of Germany it is trampled upon by men on horseback.) This pasty mass was simply pressed by hand in the shape of balls or eggs, dried in the sun, and stored under shelter until used.

It will easily be perceived that such an addition of clay increases considerably the quantity of ashes and reduces the combustible character of the coal. For the last few years it has been manufactured mechanically, and the proportion of clay has been reduced in Belgium to 20 per cent.

The only objection made to the clay process in the article referred to is, that "it must prove unsuccessful, from the fact that the combustible character of the coal waste is so considerably reduced by the mixture with it of from 10 to 20 per cent of non-combustible materials, that the product can only be burned with difficulty, necessitating either constant attention or an artificial draught." This objection is well founded when applied to even the most improved European methods, but it loses its force when applied to my process, by which the proportion of clay is reduced to 5 per cent, and the fuel manufactured rendered impervious to moisture by an outside coating, thus preventing its gradual deterioration in heating qualities when exposed to the combined action of air and moisture. It will be conceded that 5 per cent. of clay in the fuel is less objectionable than the presence of from 5 to 10 per cent of slate, and sometimes more. If the intensity of heat given by artificial fuel made with clay is not equal to that of the ordinary coal, it lasts longer

and it may safely be asked, if for domestic purposes, this will not be an advantage rather than a defect.

As before stated, clay, as a cement, can be applied to anthracite as well as to bituminous slack; the European factories demonstrate this to evidence. It only requires appropriate machinery to demonstrate the fact in this country.

Before concluding this article, I wish to say that, in my opinion, the manufacture of artificial fuel from bituminous slack and clay is destined to revolutionise the manufacture of iron in the bituminous coal regions. No bituminous coal, except the block coal used in the Brazil furnaces, in Indiana, can be used for smelting, without being previously coked. It is coked for two reasons: 1st. For the purpose of converting it into a fuel deprived of its volatile constituents, which does not become pasty when ignited, and does not run and cake together. 2nd. For the purpose of eliminating from the coal a portion of the sulphur contained as pyrites. Now, it is a well known fact that the slack or coal dust contains a very small proportion of sulphur, hardly any. Scientists and practical metallurgists almost unanimously agree that the sulphur contained in the coal combines with the iron in the furnace only at a low red heat, and it may safely be asserted that the small proportion of sulphur contained in the artificial fuel would be eliminated and the coal coked in the furnace before this combination could take place.

Basing my statements on experiments, I will add that bituminous slack, mixed with clay and moulded into lumps, will not run and cake together; that its tendency to expand will be counterbalanced by the tendency of the clay to contract, and that in any kind of heating apparatus, stove, grate, or furnace, it will coke gradually from the outside surface to the centre, each lump becoming, so to say, a small retort, the gases escaping through a heated surface and being consumed, instead of escaping into the flue; the coal throwing no sparks from the grates and emitting a light, greyish smoke, instead of the black, dense smoke peculiar to the bituminous coal.—*Engineering and Mining Journal.*

ON A

NEW ANGLE-MEASURER AND PROTRACTOR FOR FACILITATING THE PROCESSES OF FIELD SKETCHING AND SURVEYING.*

By W. H. COLLINS, Lieut. R.E., F.R.A.S.

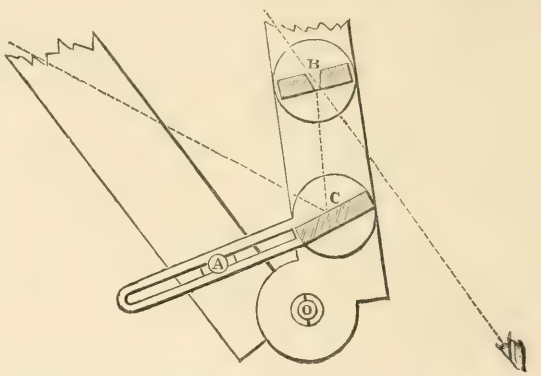
THE figure represents an instrument which I am desirous of submitting to the notice of the members of the Royal Dublin Society. This instrument has been designed by me to facilitate the operation of field sketching and military reconnoissance.

Land surveys of large extent are based upon *angular* measurement; a short distance only is measured, and the longer distances are inferred by calculation. In surveys of small extent, all measurement is linear, and the areas enclosed by any assigned figure, bounded by straight lines, can be easily estimated, but such procedure ceases to be possible where the boundary lines are long, or the tract to be covered by the survey is large. With surveys pretending to much accuracy, the angular measurement must be made the basis of trigonometrical calculation, the calculated distances containing the error of the original line in an increased proportion.

When it is unnecessary to obtain great accuracy, the angles ascertained may be plotted upon paper, and the loci of points determined, the intersections of such loci defining the position of remote points.

This latter procedure is that of necessity adopted in military reconnoissances and other cases, where the work must be rapidly executed and extreme accuracy is not necessary. The instruments usually made use of are the pocket sextant and the prismatic compass; the first is accurate, though inconvenient, and the latter convenient, though inaccurate. The instrument proposed by me as a substitute for both sextant and compass is a reflecting instrument, so contrived as to *exhibit* the angle subtended at the eye by two objects.

Reflecting angle-measuring instruments are based upon the fact that the angle through which a mirror is turned is a measure of the angle through which a ray of light reflected by it is displaced—the former being half the latter. In the sextant, an index arm is attached to the reflector, and made to traverse a graduated arc. This arc is divided so as to contain twice the number of degrees that it really holds, and, consequently, any angle read off represents twice the angle through which the mirror has been turned, or the angle between the two positions of the reflected ray. The graduations of the arc are necessarily crowded together, each 30′ representing 1°, 1° representing 2°, &c. The difficulty of reading the angle is increased, while the accuracy of the reading is diminished. In field sketching, such as that referred to above, where angles are plotted upon paper and are not used as the basis of calculation, the value of the angles in degrees and minutes is not required, inasmuch as no use would be made of such values beyond the arriving at the position



Points A and C equidistant from O, the centre of pivot; the mirror, B, is parallel with C when the instrument is closed.

of a line on the paper. The reading of the angle by a microscope and vernier becomes an inconvenient step, and one gladly to be dispensed with if possible. The protactor, also, with which the angle would be plotted, does not read within 30′, while the vernier reads to a second.

Under these circumstances it appeared desirable to produce an instrument which would exhibit in itself the angle subtended at the eye by two points, and allow it to be plotted at once, and thus remove the necessity for intermediate operations. Such an instrument is that represented by the figure. It becomes necessary to contrive two angular motions depending upon each other, one half the other. If a reflector moved with the first, the second would represent the movement of the reflected ray. Cog-wheels were the first expedient that suggested itself to procure such a motion, but these were abandoned for what appeared more desirable, viz., the geometrical necessity of some figure. That of which I have availed myself is this—that the base of an isosceles triangle moves with half the angular motion of one of its sides, the other remaining fixed, and the angle of the vertex being supposed to expand. After much adaptation and alteration, the instrument took the form shown in the figure. The centre of the sector is made the centre of the isosceles triangle, at the extremity of one leg of which is the centre of the index mirror, at the extremity of the other the centre of

* A paper read before the Royal Dublin Society.

the movable spud, A, which slides between two guides upon the base.

The operation of the instrument is obvious on looking at the figure. When the legs are closed the two mirrors are parallel, and the object seen *direct* over the smaller mirror is seen also reflected in it. On opening the instrument, other objects are seen reflected in the small mirror, and the angle exhibited by the legs is that subtended at the centre of the movable mirror by the two objects, seen one direct, and the other by reflection immediately below. The pivot is pierced with a small hole, to allow the paper to be seen through, and to allow a pencil-mark to be made. The right-hand object is looked at, and reflected image of the left-hand object made to appear below it in the small glass.

This instrument has been tested both with a theodolite and quadrant, and the angles in each case plotted upon paper; the results were identical.

BEHAVIOUR OF ETHER WHEN IN CONTACT WITH OTHER SUBSTANCES.

By A. LIEBEN.

In my treatise on "The Origin and Production of Iodoform and on the Application of these Reactions" (*Ann. d. Chem. u. Pharm., Supplm.* 7, p. 221), I have said that when ether is shaken up with water and the water then treated with iodine and potassa no iodoform is formed, if the ether is perfectly pure; but I also observed that it was difficult to obtain pure ether, since the simple contact of ether with water, even at the ordinary temperature, and far more rapidly at 100°, causes the ether to become contaminated with alcohol. I have further investigated this subject by first trying whether perfectly pure ether, when kept alone, remains unaltered, and also, whether contact with water always produces alteration; while I lastly tried the effect of substances usually employed for drying ether. This research appeared to me to be the more interesting, since the high sensitiveness of the iodoform reaction affords a means of detecting slight alterations. When a compound so fixed and stable as ether is subject to changes hitherto scarcely thought of, it seems reasonable to conclude that other substances also undergo alterations, which are not detected for want of reagents.

Ether by Itself.—I have in another paper described the methods of making perfectly pure ether; I only mention here that it is best to re-distil the ether so obtained once or twice over sodium, chloride of calcium tubes being fitted to the distilling apparatus to avoid the contact of moist air. Ether so purified, and kept in well-stoppered bottles, continues good for several months; even after fifteen months no iodoform reaction was exhibited, and I therefore conclude that pure ether kept as stated does not become altered, at all events not sufficient to be detected by the iodoform reaction.

Ether with Water.—I repeated my former experiments by pouring ether and water or ether and dilute sulphuric acid in glass tubes, and after sealing I heated these tubes for twenty-four hours to 100°; on testing the water afterwards I detected a strong reaction of iodoform, due to formation of alcohol, while, on the other hand, a sealed tube, also containing water and ether, kept during the same period of time at the ordinary temperature, did not exhibit this reaction. I also found by separate experiments that when the sealing of the glass tubes is carefully proceeded with there is no chance that any iodoform-producing substance (aldehyde, for instance, due to the action of the red-hot glass on the vapour of ether) can be generated; it is therefore quite certain that when ether and water are heated to 100° alcohol is in a short time formed. The same action between ether and water obtains at the ordinary temperature, but only after the lapse of a considerable time; ether kept with water in well-stoppered bottles exhibited the iodoform reaction after some three or four months, but in some instances the reaction was obtained in a shorter time. Both the ether and water were pure.

Ether and Sodium.—Pure ether kept in contact with small lumps of sodium in a well-stoppered bottle was found after six months to exhibit no iodoform reaction.

Ether and Chloride of Calcium.—Pure ether kept with lumps of freshly-ignited chloride of calcium in a well-stoppered bottle for a period of six months was found on being tested to distinctly exhibit the iodoform reaction, and consequently the ether had undergone alteration.

Ether and Caustic Potassa.—Pure ether and freshly-prepared fused caustic potassa kept for six months was found to be unaltered; and the same result was obtained when the ether was kept for the same lapse of time with recently burnt caustic lime. When the pure ether was kept for six months along with freshly-ignited chloride of sodium it exhibited a distinct iodoform reaction, but with freshly-ignited carbonate of potassa no such reaction was obtained after the same lapse of time.

Ether and Anhydrous Sulphate of Copper.—When sharply dried (dehydrated) sulphate of copper and pure ether are kept for six months in a well-stoppered bottle the ether exhibits no physical appearance of change, but on testing the ether it exhibits distinctly the iodoform reaction. A portion of the same ether employed in these experiments was kept alone, and having been tested after six months did not then exhibit any trace even of formation of iodoform. I cannot explain the reason why certain neutral and anhydrous substances ($CaCl_2$, NaCl, $CuSO_4$) should have any peculiar effect on ether without entering into hypotheses which are not proved; it appears that basic substances do not act upon ether, while acids and salts affect it. We might suppose that ethylates are formed, for instance:—

$$CuSO_4 + C_2H_5OC_2H_5 = Cu\begin{matrix}-OC_2H_5\\-O-SO_2-OC_2H_5,\end{matrix}$$

and that by the operation of testing for iodoform alcohol is formed by the action of water; but it is also possible that a small portion of the ether is converted into alcohol and ethylen. The main point of interest in these researches is that perfectly pure ether can be kept by itself in well-stoppered bottles without alteration, and also when in contact with perfectly dry and previously thoroughly ignited KHO, $CaOK_2CO_3$, and also with pure sodium, but the ether cannot be kept with water, $CaCl_2$, NaCl, or $CuSO_4$, because when in contact with these substances it is gradually altered.—*Annalen der Chemie und Pharmacie.*

SUINT.

In nothing is the spirit of the age more clearly shown than in the efforts made to utilise waste substances. This is being done with such effect that what was formerly got rid of with great difficulty and at considerable expense may become one of the most important objects of manufacture. We need only point to such matters as sewage, the slag of furnaces, the fine coal of commerce, the waste of pyrites used in the manufacture of sulphuric acid, &c., as illustrations. Quite a recent instance of this improved economy is found in the treatment of the wool of sheep. It has been ascertained that sheep derive from the soil upon which they pasture a considerable amount of potash, which, after it has circulated in the blood, is excreted from the skin with the sweat, and remains, generally in connection with this, attached to the wool. Chevreul discovered, some time ago, that this peculiar mixture, known by the French as suint, constitutes not less than one-third the weight of the raw merino fleece, from which it is easily removed by immersion in cold water. In ordinary wools the suint is less, the amount being about 15 per cent of the raw fleece. Formerly it was

considered as a kind of soap, mainly for the reason that the wool, besides this, sometimes contained about 8 per cent, or a not inconsiderable quantity of fat. This fat, however, is usually combined with earthy matters, mostly with lime, and consequently forms a soap which is very insoluble. The soluble suint is a neutral salt arising from the combination of potash with a peculiar animal acid, of which little more is known than that it contains saltpetre. Special effort has lately been directed to suint, in order to obtain as much as possible of the potash eliminated from the animal, and a special industry has been established in various portions of the great French wool district, such as Rheims, El Bœuf, &c.

A company purchases from the wool raiser the solution of the suint obtained by rinsing the wool in cold water, the price paid for it being higher in proportion as it is more concentrated. As a general thing it is maintained that a fleece weighing nine pounds contains about 20 ounces of suint, which should contain about one-third part, or six to seven ounces, of potash, although not more than five and one-half ounces are perhaps directly available.

In the wool manufactories of the towns just referred to, there are nearly 60,000,000 pounds of wool washed annually, the yield of about 6,750,000 sheep. This quantity should contain over 3,000,000 pounds of pure potash. Thus, the water in which the wool is washed, and which has been heretofore thrown away, is made to yield a product, adding appreciably to the value of the wool itself, and more than covering the cost of its treatment. It is, of course, not an easy matter to utilise this solution of suint on a small scale; but wherever the work is carried on by the wholesale, as it is in connection with all great manufacturing establishments, it will undoubtedly become a regular part of the process of manufacture.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, January 16th, 1872.

Professor FRANKLAND, D.C.L., F.R.S., President, in the Chair.

AFTER the minutes of the previous meeting had been read and confirmed, Messrs. Philip Braham, A. Percy Smith, and J. Wills were formally admitted Fellows of the Society.

The names of Messrs. Edward Dillon, J. Perry, G. Brownen, T. W. Sheppard, T. C. Sellars, H. Y. Loram, and W. Sharpleigh were read for the first time; and those of Messrs. George Washington Arnott, James Scott McGregor, and Cornelius A. Mahoney were read for the third time, after which these gentlemen were balloted for, and duly elected Fellows of the Society.

The first paper, entitled "*Notes on Various Chemical Reactions*," by Mr. DAVIES, was then read by the Secretary.

The first note was on the *Formation of Crystallised Copper Sulphide*. The author found that, when copper is covered with a layer of carbon disulphide, and a layer of ammonia is superposed, that the metal becomes covered with beautiful green crystals of copper sulphide in the course of a few days.

In the second note, on *Bromised Hypochlorite of Lime*, the author remarks that a solution of hypochlorite of lime, to which bromine has been added, may be advantageously employed, in the place of hypochlorite of lime, for the precipitation of cobalt from a solution containing this metal together with nickel. The precipitation does not take place instantaneously, heat being necessary to produce the reaction.

The third note was on *Barium Bisulphide*. It was found possible to obtain this substance as a fine yellow-coloured product by shaking a solution of barium chloride with a mixture of ammonium sulphide and carbon disulphide. It is insoluble in alcohol, soluble in water, and rapidly dissolved by slightly acidulated water.

The Secretary then read the second paper, entitled "*On Ethyl-Amyl*," by HARRY GRIMSHAW. The ethyl-amyl employed in this research was obtained by submitting a mixture of ethyl-bromide and amyl-bromide to the action of sodium, it being found that the alcoholic bromides were well adapted for this purpose, the yield of hydrocarbon being highly satisfactory. By fractionating the product, ethyl-amyl, boiling at 90°, was obtained. It was converted by chlorine into a chloride, $C_7H_{15}Cl$, boiling between 140° and 150°, and this, when treated with potassium acetate and glacial acetic acid, yielded the corresponding acetate, accompanied by a certain quantity of heptylene boiling at 91°. The acetate, on treatment with alcoholic potash, gave a mixture of alcohols which, on oxidation, yielded an acid whose silver salt had the composition $C_7H_{13}AgO_2$, and a ketone, $C_7H_{14}O$, boiling at 144°, which yielded, on oxidation, a mixture of valerianic acid and acetic acid. The author considers that the mixture of alcohols consists of primary isoheptyl alcohol and methyl-amyl-carbinol, the former yielding, on oxidation, iso-œnanthylic acid, $C_7H_{13}HO_2$, and the latter yielding Popoff's ketone, $C_7H_{14}O$, which, by further oxidation, yields valerianic and acetic acids. These researches point to the conclusion that ethyl-amyl is dimethyl-butylene-methane.

The PRESIDENT, after expressing the thanks of the Society for this communication, remarked that the present investigation was characterised by a singular thoroughness, and it might well be taken as a model by other investigators. He was struck by the success with which the author had employed bromides in the place of iodides; also by the large yield of hydrocarbons which had been obtained, notwithstanding the fact that the use of sodium has generally a tendency to increase the amount of secondary products in reductions of this kind.

A paper on "*The Heptanes from Petroleum*," by Dr. C. SCHORLEMMER, F.R.S., was then read by the Secretary.

In a previous paper the author alluded to a hydrocarbon, having the composition C_7H_{16}, and boiling at about 90°, which was obtained from Pennsylvanian petroleum. Thinking it probable that this might be identical with ethylamyl, he submitted it to a new examination. The boiling-points of several of its derivatives were found to correspond with those of ethylamyl, and the oxidation of its alcohol gave rise to an acid very similar to the corresponding acid from ethylamyl; also to a ketone boiling at 144°, but which, unlike that derived from ethylamyl, yielded nothing but acetic acid on oxidation. Hence it is certain that this hydrocarbon is not identical with ethylamyl. Its constitution and that of the ketone obtained from it will form the subject of future investigations. The author is, however, inclined to regard it as dimethyl-diethyl-methane. During the conversion of the chlorides from normal heptane into acetates a portion of heptene (heptylene), boiling at 98° to 99°, was formed. About half of this combined with cold hydrochloric acid, while the remaining portion did not unite with this acid until heat was applied. The two isomeric chlorides thus separated were re-converted into olefines, both of which boiled at 98°. When heptene, boiling at 90° to 91°, is treated with cold hydrochloric acid the greater portion dissolves, while not much more than half of the heptene prepared from ethylamyl combines in the cold with this acid, a heptyl chloride, boiling at 134° to 137°, being formed.

The PRESIDENT, in returning thanks, remarked that this interesting paper was a new proof of Dr. Schorlemmer's success in the investigation of very complex hydro-carbons. The new method of separating the isomeric ole-

fines being likely to be of great service to future investigators.

A paper on "*The Vanadates of Thallium*," by THOMAS CARNELLEY, was then read by the Secretary. In this paper the following salts are described:—Thallium orthovanadate, Tl_3VO_4, or tetravanadate, $Tl_{12}V_4O_{16}$; thallium pyrovanadate, TlV_2O_7, or hexavanadate, $Tl_{12}V_6O_{21}$; Beta thallium vanadate or orthovanadate, $Tl_{12}V_5O_{26}$; Gamma thallium vanadate or decavanadate, $Tl_{12}V_{10}O_{37}$; thallium metavanadate, $TlVO_3$, or do-decavanadate, $Tl_{12}V_{12}O_{36}$; and Delta thallium vanadate or tetrakaidecavanadate, $Tl_{12}V_{14}O_{41}$. These salts were obtained either by precipitation or by fusing thallium carbonate with the requisite amount of vanadic anhydride, or of one of the salts already formed. They form in most instances yellowish precipitates, or reddish brown fused masses. *Beta silver vanadate or octovanadate*, $Ag_{12}V_8O_{26}$, was obtained as a dark yellow dense precipitate by adding silver nitrate to a solution of the salt, $Na_{12}V_8O_{26}+12H_2O$; this salt, *Beta sodium vanadate or octovanadate*, being obtained by fusing together the requisite proportions of sodium carbonate and vanadic anhydride. It is soluble in water, but does not crystallise readily.

The PRESIDENT remarked that these researches were interesting, as they illustrate the analogy existing between the vanadates and the phosphates.

A communication, by T. KINGZETT, on "*The Formation of Disodic Sulphide by the Action of Dihydric Sulphide upon Sodic Chloride at High Temperatures*," was then read. The author finds that when coal gas containing hydrosulphuric acid, or this gas in a pure state, is passed over sodium chloride heated to redness, a considerable portion of the salt is decomposed, the product being sodium sulphide. After thanking the author for this communication, the President observed that it would be of considerable interest to determine the exact amount of sodium sulphide formed under given physical conditions.

Mr. P. BRAHAM then exhibited the apparatus which he has devised for the prosecution of physical research under the microscope. Arrangements were made for observing the behaviour of bodies when placed in different positions with regard to the magnetic field, and when submitted to the influence of the induction spark at various pressures. Mr. Braham made some remarks on the appearances presented when the spark leaves the conducting wire and passes through rarefied air; this latter appearing, under some circumstances, to be a better conductor than silver. This phenomenon only takes place when there is a break in some part of the circuit.

After expressing a hope that the author would soon communicate to the Society some of the results obtained with his apparatus, the PRESIDENT announced that the meeting would then adjourn till Thursday, February 6, when the following papers will be read:—"*On Anthrapurpurin*," by W. H. Perkin; "*On the Solidification of Nitrous Oxide*," by T. Wills; and on "*Isomerism in the Terpene Family*," by Dr. C. R. A. Wright.

NOTICES OF BOOKS.

The Retrospect of Medicine. Edited by W. BRAITHWAITE, M.D., and JAMES BRAITHWAITE, M.D. (Lond.) Vol. LXVI., July to December, 1872. London: Simpkin and Marshall.

A USEFUL summary of the progress of the medical sciences during the last six months. As matters falling more especially within our sphere we notice Dr. Richardson's new anæsthetic, a mixture of ether and methylene, and Dr. Seegen's method of detecting sugar in urine by filtration over animal charcoal before the application of Trommer's test, which without this precaution is deceptive. A process is recommended for detecting nitrogenous substances in drinking-waters. The sample is concentrated to one-eighth its bulk, without boiling. The residue is mixed when cold with its own volume of concentrated sulphuric acid. When cold a strong solution of green vitriol is carefully added, so as to float upon the surface of the mixture, when the presence of nitrogen is shown by a dark line at the junction of the two liquids. We must caution persons using this test to ascertain first the absence of nitrogenous compounds in the sulphuric acid, or they will be deceived.

CORRESPONDENCE.

THE ESTIMATION OF SULPHUR IN PYRITES.

To the Editor of the Chemical News.

SIR,—Allow me to reply to the letter of "Experience" in the CHEMICAL NEWS, vol. xxvii., p. 33. He says "he cannot see that my paper is a very valuable contribution to our knowledge on the estimation of sulphur in pyrites." . . . . "And that anyone having had much experience with the estimation of sulphur in pyrites would never resort to the incorrect method of fusion." "Experience" is probably unaware that there are chemists who employ both the fusion and the acid processes, in conjunction, however, with titration by barium chloride.

"Experience" "would prefer the fusion process in platinum crucibles to all others if it gave correct results," and asks me to describe the method by which I get such good results. My article answers this question, and is on that account, perhaps, a valuable contribution to the knowledge of "Experience" himself, since it enables him to work the fusion method with better results.

At the conclusion of his letter, the writer speaks of the purification of the barium precipitate; if he will refer to my article he will see that I am dealing with a volumetric, and not a gravimetric, process. In the single gravimetric experiment given, the precipitate was not purified; the correctness of the result is therefore possibly accidental. I am aware that the sulphur is found to be higher in the fusion than in the acid process, where the fusion is made in a crucible.

In 1864, Dr. David Price called attention to the fact that a not inconsiderable amount of sulphur is found in a simple fusion of alkalies in a crucible over a gas-flame; this, however, was only the case when the mixture crept over the sides of the crucible. In his experiments, three-quarters of an hour's heating was sufficient to give an appreciable amount of sulphur. This observation will scarcely account for half a per cent of sulphur above that found by the acid process.—I am, &c.,

PHILIP HOLLAND.

MISCELLANEOUS.

London International Exhibition, 1873.—The third meeting of the Committee on Surgical Instruments and Appliances was held on Monday afternoon at the offices, Gore Lodge, and the following members were present:—Mr. Cæsar H. Hawkins, F.R.S. (in the chair), Dr. P. Allen, Mr. R. Brudenell Carter, Mr. W. White Cooper, Sir W. Fergusson, Bart., F.R.S., Dr. Arthur Farre, F.R.S., Dr. G. T. Gream, Mr. Prescott Hewett, Mr. J. Hinton, Mr. J. Luke, F.R.S., Mr. T. W. Nunn, Dr. W. S. Playfair, Mr. Edwin Saunders, and Mr. Edwin Sercomb. Major-General Scott, C.B., Secretary to Her Majesty's Commissioners, attended the meeting. The Committee considered the following resolutions, which were passed at a meeting of London surgical instrument manufacturers held on the 10th inst., Mr. Louis Blaise in the chair:—"(1) That the surgical instrument manufacturers do not exhibit unless the conditions regarding their manufactures to be submitted to a Committee of Selection be withdrawn;

(2) that they may exhibit all the articles of their manufacture as a whole, and not in sections or subdivisions as proposed by Her Majesty's Commissioners; (3) that the conditions upon which the foreigner and Englishman exhibit shall be one and the same." It was recommended that a reply should be sent, explaining that English and foreign exhibitors would, as always intended, be on precisely the same footing; that it is not proposed to separate an exhibitor's instruments into sections or subdivisions; and that, while it is unadvisable to dispense generally with the principle of acceptance on the approval of a committee, an assurance of admission might be given by the Committee to manufacturers of very high repute who should notify their desire to exhibit. The Committee was informed that Signor A. Castellani, of Rome, had commenced to make exact reproductions of the surgical instruments found at Pompeii, and that the Japanese minister, Terashima Munerero, himself a physician, had promised to obtain a collection of surgical instruments from Japan. Letters were read from Sir Alexander Armstrong, K.C.B., Sir John Rose Cormack, M.D., of Paris, the Royal College of Surgeons, the Royal College of Physicians, University College, and the University of Edinburgh. The Committee then adjourned till Monday, February 17.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, January 13, 1873.

This number contains the following original papers and memoirs relating to chemistry:—

Researches on the Allotropic Transformations of Phosphorus.—L. Troost and P. Hautefeuille. The contents of this essay record some calorimetric measures and experiments made with the view to explain the calorific phenomena which accompany the formation of the allotropic modifications of some substances.

New Process of Steel-Making.—F. Bajault and M. Roche.—The authors describe a process based upon the decarburation of pig-iron when intimately mixed with some rich iron ores, and kept fused in crucibles or reverberatory furnaces for some time. A specimen of steel thus made was, on analysis, found to contain, in 100 parts:—Combined carbon, 0·43; non-combined carbon, 0·080; silicium, 0·23; phosphorus and sulphur, none. The steel thus prepared is malleable, strong, and becomes hard by annealing.

Sulphurous and Chlorosulphuric Acids—Combination of Chlorine and Hydrogen in Complete Darkness.—Professor Melsens.—This lengthy essay treats, in the first place, on the preparation of pure and dry sulphurous acid gas, which the author states is best obtained by causing strong sulphuric acid at a high temperature to act upon sulphur. Chlorosulphuric acid, SO_2Cl, is readily obtained by passing chlorine and sulphurous acid gas into strong acetic acid. The author further describes at length a series of experiments, the result of which is, that properly prepared charcoal may be made to absorb its own weight of chlorine; when such charcoal is placed in a vessel filled with hydrogen, hydrochloric acid is formed, while the temperature of the vessel and contents becomes considerably lower. The chlorine-containing charcoal decomposes water at the ordinary temperature, with formation of hydrochloric and carbonic acids.

Statics of Saline Solutions.—Dr. Berthelot.—From his thermochemical researches, the author concludes that, when strong acids and strong bases are together present in a solution, the stronger acids combine with the stronger bases, and the weaker acids with the weaker bases.

Polypropylenic Carburets.—M. Prunier.—This essay treats on the formation of certain hydrocarbons, by the reduction of bromide of propylen by means of nascent hydrogen. The hydrocarbon obtained by the author is probably a dipropylen, $(C_6H_6)_2$; it boils at 70°.

Anti-Ferment Properties of Silicate of Soda.—M. Picot.—This exhaustive essay treats on the physiological action of silicate of soda. It appears, from the author's researches, that the silicate is not only an anti-ferment, but that it is actually a poison, since it destroys the blood globules, and kills by causing asphyxia.

Memoir on Chlorophyll.—A. Millardet.—The author refers first to Chautard's last paper on this subject, and then states that he has found chlorophyll unaltered in the animal organism, and that certain insects which feed on leaves owe their green colour to this substance.

Analysis of the Lanarkite of Leadhills.—F. Pisani.—It appears from this exhaustive essay that, according to some of the older analyses, lanarkite contains some carbonate of lead, and is readily soluble in nitric acid. The author has tested a large number of samples of this mineral kept in different museums, and he has found none containing carbonic acid. According to his analysis, lanarkite consists, in 100 parts, of—Oxide of lead, 82·73; sulphuric acid, 15·10; loss by heat, 0·83; total, 98·66. Formula, $\dot{P}b_2\ddot{S}$; that is, a basic sulphate of lead.

Use of Gas for the purpose of Producing a High Temperature.—L. Forquignon and A. Leclerc.—The detailed description of a contrivance by means of which a high temperature may be readily produced, regulated, and maintained.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 20, 1872.

The following original memoirs and papers are published in this number:—

Synthesis of Phenyl-Butylen.—B. Aronheim.—After briefly referring to some unsuccessful experiments made in the direction alluded to, viz., the synthesis of hydrocarbons of the $C_6H_5-\text{---}C_nH_{2n}-1$ series by the reaction of sodium upon the halogen combinations of the corresponding alcohol radicals, the author describes at length his researches, made with the view of preparing, synthetically, phenyl-butylen by the reaction produced in mixture of the proper atomical quantities of benzyl-chloride and iodallyl in ether by metallic sodium in excess. The result of this operation gave, in addition to some other substances, phenyl-butylen, $C_{10}H_{12}$; boiling-point, 176° to 178°; vapour density, 132; sp. gr. at 15·5°=0·9015; formula of formation—

$$C_6H_5.CH_2Cl+CH_2 =:=CH-\text{--}CH_2I+Na_2=$$
$$=C_6H_5-\text{--}CH_2-\text{--}CH_2-\text{--}CH =:=CH_2+NaCl+NaI.$$

New Synthesis of Anthracen.—W. A. Van Dorp.—In the first part of this essay, the author discusses at length the nature of a fluid hydrocarbon which appears to be met with in crude anthracen, and which has been stated by various authors to be dibenzyl, or isomeric with ditolyl or benzyl-toluol. In the next part, the author describes at length, and elucidates by complex formulæ, the synthetical formation of anthracen from benzyl-toluol (prepared in pure state), by passing the vapours of that hydrocarbon through a red-hot porcelain tube filled with lumps of pumice-stone. The anthracen is thus readily obtained pure, although the quantity is small. An oily compound is also given off, which again yields anthracen by the same treatment.

Preliminary Notice.—R. E. Meyer.—This essay, elucidated by a series of lengthy and complex formulæ, treats on a general method of the formation of keton acids by the aid of ethyl-oxalic acid salt (*aethyl-oxalsauren salze*).

Composition of Suint.—E. Schulze.—After referring to researches on this subject made by Hartmann and himself, the author states that, when suint (the fatty matter present in crude wool) is treated with boiling-hot alcohol, it yields cholesterine, partly soluble in the boiling alcohol; and the portion which is insoluble therein is found to consist partly of the same fatty substance, and partly of benzoic acid-cholesterine-ether; the methods of separating these bodies are referred to at length. It appears that the composition of suint is rather complex, because acetic acid-cholesterine-ether seems also to be present therein.

Lecture Experiments made with the Thermo-Analysator.—E. Mulder.—The detailed account, illustrated by a woodcut exhibiting the apparatus just named, of some experiments made by the author for exhibiting the decomposition, by the aid of heat, of various substances, such as hydrochloric acid gas, phosphuretted hydrogen, &c.

Action of Zinc-Ethyl upon Silicic Acid-Methyl-Ether.—A. Ladenburg.—This essay records at great length the results of the reaction just named; but, aided by sodium, the new substance thus formed is termed by the author ortho-silico-propionic acid-methyl-ether (*ortho-silico-propion-saure-methyl-ether*). Formula, $SiC_2H_5(OCH_3)_3$; sp. gr. at 0° = 0·9747; insoluble in water, but miscible with alcohol and ether. Some of the reactions of this ether with other substances are alluded to, and general directions given for the preparation of homologues of the silico-propionic acid.

Effects of Alcohol upon Animal Heat.—C. Binz.—A physiologico-thermical essay.

Toluol-Disulpho Acid.—C. W. Blomstrand.—An exhaustive monograph, elucidated by several tables, not well suited for abstraction.

On Pentabrom-Resorcin.—C. Liebermann and A. Dittler.—This essay treats on the formula of pentabrom-resorcin, and on the question whether the body is, or is not, an addition product. This paper is elucidated by a series of complex formulæ.

Contribution to our Knowledge of the History of the Azo-Compounds.—K. Heumann.—The author criticises Alexejeff's paper on this subject (see CHEMICAL NEWS, vol. xxvii., p. 22), and proves that he (the author) long since discovered and described several of the bodies which Alexejeff claims to have first made known.

Combinations of Aldehyde and Phenols and Aromatic Hydrocarbons.—A. Baeyer.—This monograph is divided into the following sections:—Formaldehyde and phenol; formaldehyde and pyrogallic acid, and gallic acid and benzol and mesitylen; chloral and benzol.

This number contains a condensed report of the proceedings of the meetings of the Imperial Russian Chemical Society at St. Petersburg, and also the report of the proceedings of the general annual meeting of the German Chemical Society at Berlin. As regards the former, the papers will be published *in extenso* in German periodicals. From the latter, we are glad to find that the Society is in a flourishing state; on the 14th of December last the number of members amounted to 822. At the request of many of the most prominent chemical manufacturers the North German Confederation has appointed a provisional committee to report on the chemical industries represented at the forthcoming Vienna Exhibition. We may also mention that the Municipal Government of Oranienburg (near Berlin) has agreed that the Runge memorial monument, placed in the cemetery of that town at the expense of some of the deceased's personal friends and the members of this Society, shall be properly taken care of.

Les Mondes, January 9, 1873.

Cerealine and Corn Phosphates.—MM. Devaux.—The authors have succeeded in extracting, from previously decorticated wheat, that highly-nitrogenised portion containing phosphoric acid which forms a thin, but compact, layer just inside the husk, and which, by the ordinary method of grinding wheat, is almost lost with the bran. This material, to which the name of cerealine is given, also contains a peculiar principle, in small quantity, which highly stimulates digestion. Mixed with sugar and pure powdered chocolate, it appears to be highly valued as an analeptic by the faculty in Paris.

Method of Rendering Petroleum (Paraffin Oil) thick, so as to Prevent its Danger of Causing Fire.—M. Jordery.—By means of an inert substance (the powder of *saponaria*, a vegetable material), the author renders petroleum as thick as a sauce, so as to prevent its danger owing to its fluidity, and yet not interfering with its properties; because the thickened oil may be at once rendered fluid again by the addition of a few drops of phenic or strong acetic acids.

Newly-Devised Geodesical Instrument.—Dr. La Porte.

Technical Russian Society, Section Kieff.—This institution intends to award a prize for the best essay giving a simple and rapid, as well as readily executable, method of estimating the saccharine value of beet-roots. The process should be free from the inconveniences attending the processes now known. Memoirs to be sent in on or before the 13th of September next, to M. Tschoubinski, Goroditsch Sugar Works, Spola, district of Kieff (Kiew), Russia.

Although not belonging to chemistry or collateral subjects, we call attention to the two following important papers:—

Effects Produced by the Construction of the Mont Cenis Tunnel and the Suez Canal.—Baron E. Du Menil.

Earthworms.—Dr. E. Robert.—This essay contains curious observations on the utility of worms to agriculture and horticulture.

January 16, 1873.

Bibliography.—Under this heading attention is called to the following work:—"Climat, Géologie, Faune, et Géographie Botanique du Brésil," par M. Emmanuel Liais. This work, published by the Imperial Brazilian Government, contains correct and highly interesting information on Brazil. The author, a Frenchman, has thoroughly surveyed and explored this large empire, and in his work gives a faithful record of its mineral and other resources, as well as of its botanical productions and animals.

Petites Annales de Chimie.—E. J. Maumené.—The tenth part of a monograph. This portion, treating on fermentation without ferments, is elucidated by a large number of algebraico-chemical formulæ, and is, like the former parts, written to thoroughly explain the author's views of the theory of chemistry.

American Journal of Pharmacy, January, 1873.

This number contains the following original matter bearing upon chemistry:—

Solania in Solanum Lycopersicum, the Tomato Plant.—G. W. Kennedy.—The process employed by the author for preparing solania from the fresh leaves and stems of the plant is that of Wackenroder, but substituting ammonia for hydrate of lime. The solania, separated in crystalline state, was found to have a rather nauseous taste. With sulphuric acid, it gives a bright red colour, passing to reddish brown; with iodine, a characteristic yellowish brown colour is produced. The plant further contains some fixed oil, gum, chlorophyll, and inorganic salts.

Ceresine, a Substitute for White Bees'-Wax.—J. P. Remington.—This substance is obtained by heating ozokerite to from 250° to 300° in order to separate some oily fluids. When the mass is cooled down to 60°, it is treated with from 10 to 26 per cent of Nordhausen (fuming) sulphuric acid; the temperature is then raised to 100°, and care is taken to maintain this heat until the precipitation of the carbon takes place and forms a viscous residue, which is separated from the supernatant oils, then treated with 10 per cent of dilute sulphuric acid, and then neutralised by an alkali. The mass is then heated to 180°, poured upon plates, pressed through linen cloths, in order to separate greasy matters, and the residue melted again and filtered. The product is ceresine, a substance apparently holding a middle place between wax and paraffin.

Modified Form of Crystals of Permanganate of Potassium.—J. P. Remington.—The author states that some permanganate imported from Germany was found to be, although otherwise pure, crystallised in a manner resembling a miniature heap of the salt anthracite. The cause of this divergence appears to be due to the presence of some foreign salts in the solution, from which the permanganate crystallised. The author observes that he found once, when preparing a large quantity of the permanganate, that, while the solution contained chloride and sulphate of potassium, there was also formed a double salt of perchlorate and permanganate of potassium.

Adulterated Heavy Magnesia.—R. V. Mattison.—The author details at length his tests of a sample of heavy magnesia found to be adulterated with Rochelle salt. This sample was imported into the United States from abroad.

International Exposition at Philadelphia in 1876.—Under this title, we find a proclamation of Congress to the people of the United States stating that the end of the first centennial of the existence of the Great Transatlantic Republic will be celebrated by a grand International Exhibition, to be held at Philadelphia, and to originate under the auspices of the National Legislature.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, December 19, 1872.

This number contains no original papers relating to chemistry.

La Revue Scientifique de la France et de l'Etranger, January 11, 1873.

Contains no papers relating to chemistry.

January 18, 1873.

This number contains the continuation of—

Lectures on Practical Agriculture: Receipts for Various Mineral Manures.—G. Ville.—Illustrated with woodcuts and a large number of receipts for mineral manures for different crops.

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3194. T. Cobley, Dunstable, Bedfordshire, and J. E. Poynter, Glasgow, N.B., "Improvements in obtaining caustic baryta."—Petition recorded October 28, 1872.

3924. W. McAdam, Glasgow, N.B., "Improvements in utilising waste products of chemical and other works, in order to render the same applicable for building and structural purposes."

3926. D. C. Miller, Lonkhall, Lanarkshire, N.B., "Improvements in distilling, evaporating, or concentrating saccharine and other solutions or liquids."—Petitions recorded December 27, 1872.

3930. B. White and P. T. Hendry, Glasgow, N.B., "Improvements in treating liquids to be burned for illuminating purposes."—A communication from J. Hale, jun., Cincinnati, U.S.A.—Petition recorded December 27, 1872.

3939. R. Williamson and J. Dale, Northwich, Cheshire, "Improvements in the manufacture of salt, and in apparatus employed therein."—Petition recorded December 28, 1872.

3949. J. Higgin, Manchester, and J. Stenhouse, Pentonville, Middlesex, "Improvements in treating waste liquors containing arsenical or phosphatic compounds, and in obtaining and applying useful products therefrom."

3957. J. W. Spencer, Newcastle-on-Tyne, "Improvements in the production of iron."—Petitions recorded December 30, 1872.

3959. J. Harrington, Ryde, Isle of Wight, "Improvements in the treatment of paper and other materials for the production of imitation or artificial leather."—Petition recorded December 31, 1872.

1. C. W. Harrison, High Holborn, Middlesex, "Improvements in treating certain gases for lighting and heating purposes, and in combining atmospheric air therewith."

14. G. Rawle, Bristol, and W. N. Evans, Bedminster, near Bristol, "Improvements in the manufacture of leather."

17. C. Boundy, Birmingham, "Improvements in treating waste products and other materials containing zinc for the purpose of recovering zinc and other valuable products therefrom, and in apparatus to be employed for that purpose."—Petitions recorded January 1, 1873.

38. G. Bischof, Glasgow, N.B., "Improvements in the purification of water, and in the means and apparatus employed for that purpose.

42. W. G. Thompson, Manchester, "An improved process and apparatus for extracting oleaginous or fatty matters from liquid or solid substances."—Petitions recorded January 3, 1873.

45. A. A. Croll, Coleman Street, London, "Improvements in means or apparatus for the distillation of ammoniacal liquors, which improvements are also applicable in the distillation of other liquids, and in the concentration of soluble salts."

50. P. Spence, Newton Heath, Manchester, "Improvements in obtaining valuable substances derivable from residual liquors produced in the manufacture of alum from natural phosphates of alumina."—Petitions recorded January 4, 1873.

68. J. Argall, Adderbury, Oxfordshire, "Improvements in the manufacture of oil paints."—Petition recorded January 7, 1873.

NOTICES TO PROCEED.

2527. C. Frickinger, Berlin, "Improvements in the manufacture of malleable iron, and in the furnaces employed therein."—Petition recorded August 26, 1872.

2569. B. W. Gerland, Ph.D., Macclesfield, Cheshire, and E. Johnson, Dartmouth Park, near Sydenham, Kent, "Improvements in the manufacture of sanitary charcoal, and the application thereof to the treatment of sewage."

2573. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of hydrochloric acid, and in apparatus employed therein."—Petitions recorded August 29, 1872.

2596. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of salt."—Petition recorded August 31, 1872.

2617. F. C. Danvers, Ealing, Middlesex, "Improvements in the manufacture of artificial fuel."

2619. F. R. H. Protheroe, Lydney, Gloucestershire, "Improvements in the manufacture of paper."—Petitions recorded September 3, 1872.

2630. J. W. Pollard, Mincing Lane, J. Schofield, Mark Lane, and A. Butel, Merchant Street, Bow, "Improvements in the treatment of spent oxides of iron, for the purpose of extracting cyanides."—Petition recorded September 4, 1872.

2642. C. W. Torr, Aston, New Birmingham, and J. Johnstone, Birmingham, "Improvements in furnaces for heating and melting metals and metallic alloys."—Petition recorded September 5, 1872.

2648. A. C. Duncan, and A. Duncan, Manchester, "Improvements in the production of Turkey red."—Petition recorded September 6, 1872.

2719. W. R. Lake, Southampton Buildings, London, "An improved process and compound for tempering and refining steel."—A communication from W. N. Severance, South Bend, Indiana, U.S.A.—Petition recorded September 13, 1872.

2822. C. Morfit, Baltimore, Maryland, U.S.A., "Improvements in the reclamation of materials employed in the manufacture of diphosphate and tri-phosphate of lime."—Petition recorded September 24, 1872.

3180. A. Malam, Dumfries, N.B., "Improvements in the manufacture of illuminating gas, and in apparatus therefor."—Petition recorded October 26, 1872.

3588. A. V. Newton, Chancery Lane, Middlesex, "Improvements in the manufacture of sugar, and in apparatus to be used therefor."—A communication from S. Dod, Havanna, Cuba.—Petition recorded November 28, 1872.

3678. W. R. Lake, Southampton Buildings, London, "Improvements in the manufacture of malleable cast-iron and cast-steel, and in furnaces therefor."—A communication from J. M. Roberts, Burlington, New Jersey, U.S.A.

3680. T. Petitjean, Islington, Middlesex, "Improvements in the production of metallic surfaces and articles of various forms by chemical means and the electro-deposition of metals, which surfaces or articles are produced either highly polished, dead or matted, engraved, or otherwise ornamented."—Petitions recorded December 6, 1872.

3821. J. L. F. Target, Portsdown Road, Middlesex, "Improved means or apparatus for receiving human excreta, and for distributing, deodorising, or disinfecting powder over the same."—Petition recorded December 17, 1872.

3851. S. Holker, Lumb, near Bury, Lancashire, "Improvements applicable to the treatment of straw, esparto wood, and similar substances used in the manufacture of paper."—Petition recorded December 18, 1872.

3853. F. B. Houghton, Southwark, Surrey, "Improved method of or process for treating spent hops for the manufacture of paper pulp."—Petition recorded December 19, 1872.

3882. W. W. Fereday, Dover Road, Surrey, "Improvements in treating human excreta, and in apparatus for working the excreta and converting the same into a dry and highly concentrated manure."—Petition recorded December 21, 1872.

3913. L. A. Badin, New Ormond Street, Middlesex, "Improvements in closets and apparatus for collecting and disinfecting fœcal matters and converting the same into manure or human guano."—Petition recorded December 24, 1872.

3949. J. Higgin, Manchester, and J. Stenhouse, Pentonville, Middlesex, "Improvements in treating waste liquors containing arsenical or phosphatic compounds, and in obtaining and applying useful products therefrom.—Petition recorded December 30, 1872.

PATENTS SEALED.

2118. E. C. C. Stanford, Glasgow, N.B., "Improvements in preserving and deodorising sea-weed, and in part applicable for deodorising various animal and vegetable substances."—Dated July 13, 1872.

2137. J. Dale, Manchester, "Improvements in the manufacture of oxalates of soda and potash."

2144. S. S. Bateson, Mayfair, Middlesex, "Improvements in the treatment of hides or skins."—Dated July 17, 1872.

2205. H. A. Dufrene, Rue de la Fidelité, Paris, "Improvements in concentrating and evaporating sulphuric acid and other liquids, and in the apparatus employed therefor."—A communication from M. J. F. R. Faure and J. L. Kessler, Clermont-Ferrand, France.—Dated July 24, 1872.

2286. A. Browne, Gracechurch Street, London, "Improvements and modifications in the treatment of phosphate in general, and in the production and purification of phosphoric acid and its combinations."—A communication from H. Storck, E. Hentsch, A. Hentsch, A. Lutscher, and F. Grininger, Paris.—Dated July 30, 1872.

2328. E. Packard, Jun., Ipswich, Suffolk, "Improvements in the manufacture of superphosphate of lime and artificial manure."—Dated August 3, 1872.

2369. W. R. Lake, Southampton Buildings, London, "Improved nutritious compounds."—A communication from J. R. Weed, New York, U.S.A.—Dated August 9, 1872.

NOTES AND QUERIES.

Coralline and Blackley Red.—How is coralline manufactured, and how used in dyeing? also, how is Blackley red made?—P. BURROWS.

MEETINGS FOR THE WEEK.

MONDAY, Jan. 27th.—Royal Geographical, 8½.
—— Medical, 8.
TUESDAY, 28th.—Royal Institution, 3. Prof. Rutherford, "On Forces and Motions of the Body."
—— Civil Engineers, 8.
WEDNESDAY, 29th.—Society of Arts, 8.
THURSDAY, 30th.—Royal Institution, 3. Dr. Debus, F.R.S., "On Oxidation."
—— Philosophical Club, 6.
FRIDAY, 31st.—Royal Institution, 9. Mr. Dannreuther, "Music of the Future."
SATURDAY, Feb. 1st.—Royal Institution, 3. Edward A. Freeman, D.C.L., "On Comparative Politics."

TO CORRESPONDENTS.

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Dr. B. W. Gerland.—Please forward your address, as there is a letter for you at our office.

A. B. (Widnes).—Yes, but it is little more than a reprint of the CHEMICAL NEWS.

Glasgow Philosophical Society.—Our report of the last meeting of the Chemical Section is unavoidably postponed till next week.

M. H. Cochrane.—Received.

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THE CHEMICAL NEWS.

Vol. XXVII. No. 688.

THE INVENTION OF THE WATER-AIR-PUMP.

By H. SPRENGEL.

STATEMENT.*

A LETTER addressed to me by Dr. Sprengel, under date of November 1, 1872, in which he says—"Perhaps it will not have escaped your observation that the invention of the water-air-pump, which you have constructed after the principle of my mercury-air-pump, according to your paper, published in 1868, "On the Washing of Precipitates," is almost everywhere attributed to you"—induces me to make the following statement:—

The interesting discovery that, by means of columns of liquids flowing downwards, a more perfect vacuum can be produced than was possible by the air-pumps hitherto in use, belongs solely and only to Dr. Sprengel. He, in his researches on the vacuum (*Journal of the Chemical Society*, January, 1865), brings prominently forward that water is, from a practical point of view, the only liquid which could come into consideration as a substitute for mercury, used in the instrument described by him, and that it is not unlikely that such an instrument, adapted for water, might possess advantages which air-pumps of other constructions have not, particularly in hilly countries, where the large volume of a natural waterfall might be rendered available. In the theoretical considerations on the action of his instrument, which immediately follow the above, it is noticed that it is simply the reverse of the trompe, with this addition, that the supply of air is limited, while that in the trompe is unlimited.

If, in the face of these facts, which are open to all, anyone attributed to me, as I must conclude from Dr. Sprengel's letter, a share in his discovery, I can regret this only all the more keenly, as in my treatise on the new method of filtration I could not possibly have expressed myself, with regard to Dr. Sprengel's claims, more loyally and precisely than I have done. There I have stated expressly that I have constructed the pump used for filtrations, and described by me in detail, after the principle of Sprengel's mercury-air-pump. It was the only apparatus of the kind which Dr. Sprengel described, consequently the one to which alone I could refer.

(Signed) R. BUNSEN.

Heidelberg, Nov. 5, 1872.

Expressing my best thanks to Professor Bunsen for the above statement, I beg to add that since 1860 I have been using, for laboratory purposes, a water-trompe as described by me in *Poggendorff's Annalen*, vol. cxii., which (by reversing the action) led me, in 1863, to the new method of air rarefaction. Water was the first liquid I used in my first pump, constructed during the summer of 1863; but the fallacies arising from the tension of aqueous vapour, and from the air absorbed in water, as well as the inconvenience of having to provide for the requisite fall, caused me to discontinue the use of water, and to substitute in its stead mercury, as the most suitable liquid for establishing THE truth, which I had recognised by means of a water-air-pump with an insufficient fall. My paper of 1865 was written with reference to ALL liquids; in fact, on page 15 (rendered prominent by italics) I summed up thus:—

"The main fact which I have established in this paper may be shortly stated to be, *that if a liquid be allowed to run down a tube, to the upper part of which a receiver is attached by means of a lateral tube, and if the height at which the receiver is attached be not less than that of the column of the liquid which can be supported by the atmospheric pressure, a vacuum will be formed in the receiver*, minus *the tension of the liquid employed*."

I regret that the obviousness of the matter led me to refrain from expressing myself in a more detailed manner, believing, as I still believe, that what I wrote sufficiently described the construction of the water-air-pump.

In conclusion, Mr. Johnson's aspirator,* for establishing a current of air, ought to be mentioned here. It was recognised by Professor Hofmann† to act on the principle of the trompe, and, of course, might have served as an air-pump had it been noticed at the time that the instrument would furnish the means of creating a vacuum. And I may also draw attention to the tube‡ of a vacuum-pan, through which the water is made to escape, which has served to condense the steam of the boiling liquid. This no doubt would in like manner have served as a complete water-air-pump, but it does not appear that its use, as such, was discovered.

London, Jan. 22, 1873.

* Translated from *Ann. Chem. Pharm.*, vol. clxv., p. 159, by H. Sprengel, authorised by Professor Bunsen.

CONTRIBUTIONS TO THE HISTORY OF THE ORCINS.—AMIDO-DERIVATIVES OF ORCIN.‖

By JOHN STENHOUSE, LL.D., F.R.S, &c.

IN a paper published in March, 1871,§ I stated that I had made some experiments on the action of reducing agents on trinitro-orcinic acid and trinitro-resorcinic acid; but as Dr. Schreder¶ has since published an account of some of the amido-derivatives of the latter substance, I have not pursued my investigations further in that direction, but confined myself to an examination of the products obtained from trinitro-orcinic acid.

Amido-diimido-orcin, $C_7H_5(NH_2)(NH)_2O_2$.—This compound, which has the properties of a base, is formed by the oxidation of triamido-orcin, and is most conveniently obtained in a pure state by decomposing a solution of the acetate with a slight excess of ammonia.

The most advantageous method of preparing the base is to reduce trinitro-orcin with sodium-amalgam, and to oxidise the alkaline solution of triamido-orcin by exposure to the air. The details of the process are as follows:—One part of trinitro-orcin and forty or fifty parts of water are placed in a bottle furnished with a caoutchouc cork, and fragments of sodium-amalgam containing about 3 per cent of sodium are gradually introduced and agitated with the solution, which first acquires a brown colour from the formation of an intermediate amido-product, probably analogous to picramic acid, but becomes colourless as soon as the trinitro-orcin is completely reduced. The solution should be cooled from time to time, as considerable heat is generated during the reaction. When the solution containing triamido-orcin and sodic hydrate has become cold, it is poured into a large flask and agitated briskly; by this means the triamido-orcin is oxidised to amido-diimido-orcin, and the solution assumes a magnificent blue colour.

$$C_7H_5(NH_2)_3O_2 + O = C_7H_5(NH_2)(NH)_2O_2 + OH_2.$$

A few seconds' agitation is sufficient, as if it be continued after the blue colour is fully developed, the amido-diimido-orcin in the strongly alkaline solution undergoes further oxidation, and is destroyed. On strongly acidulating the blue solution with sulphuric or hydrochloric acid, the corresponding salt of amido-diimido-orcin is precipitated.

* *Quarterly Journal of the Chemical Society*, vol. iv., p. 186, 1852.

† *Ibid.*

‡ "Elements of Physics," by Neil Arnott, M.D. (3rd edition). London: Longmans. 1828.

‖ A paper read before the Royal Society. A preliminary note on this subject appeared in the CHEMICAL NEWS, vol. xxiii., p. 292, and *Zeits. Chem.*, vol. vii., p. 414.

§ *Proc. Roy. Soc.*, vol. xix., p. 410.

¶ *Ann. Chem. Pharm.*, vol. clviii., p. 244.

Instead of directly agitating the colourless solution with air, it may be first neutralised or rendered very slightly acid with hydrochloric acid, cooled, and then rendered alkaline with ammonia. If this solution be now agitated, in the manner before described, it becomes filled with minute green needles of amido-diimido-orcin. Although the first method gives the best results, when carefully conducted, it requires considerable experience to stop the oxidation at the precise point when the whole of the triamido-orcin is oxidised to amido-diimido-orcin, and before the latter becomes destroyed. With the ammoniacal solution there is far less danger of over-oxidation.

Trinitro-orcin is also reduced by treatment with tin and hydrochloric acid, or zinc and hydrochloric or sulphuric acid. One part of trinitro-orcin and four parts of granulated tin are heated in a capacious flask with eight measures of concentrated hydochloric acid diluted with sixteen measures of water. In a short time a powerful reaction takes place, so that it is advisable to remove the flask from the source of heat in order to prevent the contents from boiling over. When the action has become somewhat moderate, the solution is boiled until it is colourless, then diluted with water, and the tin precipitated by hydrosulphuric acid. The clear solution acquires a purple tint on standing, and deposits large dark-coloured prisms of amido-diimido-orcin hydrochlorate, or the amido-diimido-orcin may be obtained directly by adding a slight excess of ammonia to the filtrate from the tin sulphide and oxidising by agitation in the presence of air, when the base immediately separates in minute green needles. Trinitro-orcin and granulated zinc are boiled in a flask with twenty or thirty parts of water, and hydrochloric acid added in small quantities at a time until the solution becomes almost colourless. The clear liquid, poured from the excess of zinc and allowed to cool, is rendered slightly alkaline by ammonia and exposed to the air. As soon as the triamido-orcin is oxidised, which may be known by the brown colour of the product, an excess of hydrochloric acid is added to dissolve the zinc oxide and precipitate the amido-diimido-orcin as hydrochloride. The yield is, however, considerably less than when sodium-amalgam is employed as the reducing agent.

The amido-diimido-orcin sulphate or hydrochlorate obtained by any of the above processes is readily decomposed by treatment with a slight excess of dilute ammonia, leaving the free base in an impure state. This should then be dissolved in warm dilute acetic acid, filtered, and precipitated by a slight excess of ammonia. Two or three solutions and re-precipitations are sufficient to render it pure.

Pure amido-diimido-orcin crystallises in small needles, which have a dark green metallic lustre by reflected light. They are insoluble in alcohol, ether, and benzol, and almost insoluble in water and dilute ammonia. Strong ammonia only dissolves the base in small quantity, yielding a pale blue solution, but it is readily soluble in a solution of sodic hydrate, with a fine deep blue colour; the solution, however, when boiled, loses its colour, ammonia being at the same time evolved. The base gives off ammonia when heated, and leaves a carbonaceous residue very difficult of combustion. As might be expected, when amido-diimido-orcin is treated with sodium-amalgam, it is re-converted into triamido-orcin.

Analysis of Amido-diimido-orcin.—0·290 grm. substance, dried *in vacuo*, lost 0·025 grm. when dried at 100°, equivalent to 8·62 per cent.

I. 0·140 grm. substance, dried at 100°, gave 0·234 grm. carbonic anhydride and 0·075 grm. water.

II. 0·290 grm. substance, dried at 100°, gave 0·487 grm. carbonic anhydride and 0·152 grm. water.

		Theory.	I.	II.	Mean.
C_7	= 84 =	45·40	45·59	45·77	45·68
H_{11}	= 11 =	5·95	5·95	5·81	5·88
N_3	= 42 =	22·70	—	—	—
O_3	= 48 =	25·95	—	—	—
	185	100·00			

It will be seen that the results of the analyses agree with the formula $C_7(CH_3)(NH_2)(NH)_2(HO)_2+H_2O$ for the substance dried at 100°, and the formula for the substance dried *in vacuo* is probably—

$$C_7(CH_3)(NH_2(NH)_2(HO)_2+2H_2O,$$

as it requires 8·87 per cent water.

Triamido-orcin.—The colourless solution obtained by the reduction of trinitro-orcin with tin and hydrochloric acid, after removal of the tin by sulphydric acid, appears to contain triamido-orcin hydrochloride along with excess of hydrochloric acid. On concentrating the solution at 100°, much of the triamido-orcin is decomposed and a considerable amount of ammonium chloride formed; whilst, although long needles of triamido-orcin hydrochloride are obtained by evaporating it in a vacuum, yet owing to their great solubility, and the readiness with which they absorb water and deliquesce, the salt has not yet been obtained in a state fit for analysis. On moistening the crystals of this hydrochloride with ammonia they become almost instantaneously converted into the metallic-green needles of the amido-diimido-orcin.

If a current of sulphuretted hydrogen be passed through a solution of ammonium sulphydrate in which amido-diimido-orcin is suspended, the latter rapidly loses its colour, and becomes converted into a sandy deposit consisting of colourless crystals. These are apparently triamido-orcin, and may be washed by decantation with a dilute solution of ammonium sulphydrate, in which they are but slightly soluble. These crystals rapidly acquire the metallic-green lustre of amido-diimido-orcin when exposed to the air, and are readily soluble in dilute acids. The hydrochloric acid solution behaves in a manner precisely similar to that obtained by the reduction of trinitro-orcin with tin and hydrochloric acid, becoming deep red, and depositing crystals of amido-diimido-orcin hydrochloride when exposed to the air.

Amido-diimido-orcin Hydrochloride.—The hydrochloride obtained in the preparation of amido-diimido-orcin, as described in the earlier part of this communication, may be purified by crystallisation from hot water; but as heat decomposes solutions of the salts of this base, it is better to precipitate a cold solution of the acetate by a slight excess of hydrochloric acid, in which the hydrochloride is but slightly soluble: the precipitate should be thoroughly washed with alcohol, pressed, and dried.

Pure amido-diimido-orcin hydrochloride crystallises in different ways, according to the circumstances under which the crystals are formed. As produced directly by adding hydrochloric acid to the blue solution of the base in caustic soda obtained from trinitro-orcin by sodium-amalgam, it forms long silky needles of a brownish-red colour; an aqueous solution of the acetate or hydrochloride precipitated by an excess of hydrochloric acid yields a mixture of these needles with rhomboidal plates; the latter are purple by reflected light, and of an olive-green colour by transmitted light. The slow oxidation of the hydrochloric acid solution of triamido-orcin obtained by means of tin and hydrochloric acid yields dark-coloured, short, thick prisms. The hydrochloride is insoluble in alcohol and ether, moderately soluble in cold water, and readily in boiling water, although the latter causes partial decomposition. Its aqueous solution is precipitated almost entirely on acidulating it with hydrochloric acid; but the salt is soluble in concentrated hydrochloric acid, especially when warm, forming a purple solution. On boiling this the salt is rapidly decomposed, and the colour changes to a dirty green.

Analysis of Amido-diimido-orcin Hydrochloride.—0·428 grm. substance, dried *in vacuo*, lost 0·035 grm. when heated to 100°, corresponding to 8·41 per cent water.

I. 0·255 grm. substance, dried at 100°, gave 0·180 grm. argentic chloride.

II. 0·232 grm. substance, dried at 100°, gave 0·164 grm. argentic chloride.

III. 0·344 grm. substance, dried at 100°, gave 0·242 grm. argentic chloride.

		Theory.	I.	II.	III.	Mean.
$C_7H_{10}N_3O_2$	= 168·0	82·55	—	—	—	—
Cl	= 35·5	17·45	17·47	17·49	17·49	17·45
	203·5	100·00				

These results correspond nearly to the formula—

$$C_6(CH_3)(NH_2)(NH)_2(HO_2)HCl$$

for the substance dried at 100°; and the formula—

$$C_6(CH_3)(NH_2)(NH)_2(HO)_2HCl+H_2O$$

requires 8·13 per cent water, and would therefore appear to be that of the substance dried *in vacuo*.

Amido-diimido-orcin Sulphate.—This salt is readily prepared by precipitating a dilute solution of the acetate with sulphuric acid, when it forms minute lustrous plates, which are purple by reflected light. By slow crystallisation from a hot aqueous solution it may be obtained in large leaf-like plates. It somewhat resembles the hydrochloride in its properties, but is much less soluble in water.

Analysis of Amido-diimido-orcin Sulphate.

I. 0·255 grm. substance, dried at 100°, gave 0·128 grm. barium sulphate.

II. 0·284 grm. substance, dried at 100°, gave 0·143 grm. barium sulphate.

		Theory.	I.	II.	Mean.
$(C_7H_{12}N_3O_3)_2$	= 372	79·49	—	—	—
SO_4	= 96	20·51	20·65	20·72	20·69
	468	100·00			

The formula of this salt would therefore appear to be—

$$C_6(CH_3)(NH_2)(NH)_2(HO)_2]_2SO_4+H_2O.$$

Amido-diimido-orcin Nitrate is prepared, like the sulphate, by adding a slight excess of nitric acid to a moderately strong solution of the acetate, and washing the precipitate with alcohol. It closely resembles the sulphate in appearance, but is much more soluble in water. When heated with excess of nitric acid it is decomposed, yielding a yellow solution, which, on being evaporated, leaves a mixture of oxalic acid and an amorphous yellow substance.

Amido-diimido-orcin Acetate.—Amido-diimido-orcin dissolves readily in acetic acid, and on carefully evaporating the solution, at a low temperature, the acetate is obtained in ill-defined crystalline plates having a purple iridescence. It is readily soluble in cold water, but only slightly soluble in glacial acetic acid.

Amido-diimido-orcin Oxalate.—Very slightly soluble purple scales obtained by precipitating a solution of the acetate with oxalic acid.

Amido-diimido-orcin Picrate.—On adding a solution of picric acid to a dilute solution of amido-diimido-orcin acetate, and washing the precipitate with alcohol, the picrate is obtained in iridescent green needles and plates. It is insoluble in alcohol, and but slightly soluble in water.

I cannot conclude this paper without acknowledging the very efficient aid I have received from my assistant, Mr. Charles Edward Groves, in conducting this investigation.

ON ULTRAMARINE.*

By C. UNGER.

Although ultramarine has been frequently the subject of research, its chemical nature has not hitherto been well elucidated, and the supposition that it contains sulphuret of aluminium or sulphuret of sodium, or a polythionate of soda, becomes a dubious matter, seeing that ultramarine is not decomposed by fused chlorate of potassa, while it (the ultramarine) resists, for some length of time, fusion with alkalies and nitrates. Ultramarine, when ignited with soda-lime, yields only a trace of ammonia; but, when ignited with phosphor salt, or with an alkaline bisulphate, nitrogen is largely given off. This reminds me of an old observation made by the late Berzelius, who states, in his treatise on the blowpipe, that, when *lapis lazuli* is treated with phosphor salt, the mineral is dissolved with a continuous effervescence yielding a colourless bead. Nothing is said as regards the nature of the gas alluded to; it is probable, however, that even then it may have been known that *lapis lazuli* contains nitrogen. When I analysed a sample of artificially-made ultramarine, free from sulphuret of sodium, as well as from any acid of sulphur, I found that sample to contain—deductions being made for some kaolin which had escaped the process of conversion, and for some soda separated by treating the residue left after my operations with chloride of ammonium—upon 12·6 per cent of sulphur, 5·5 per cent of nitrogen, or equal atoms of each of these elements, and further—

	Per cent.
Sodium	14·1
Aluminium	14·4
Silicium	20·4
Oxygen found by loss	33·0

Nearly, if not quite, all the oxygen contained in this ultramarine is evidently combined with sodium, aluminium, and silicium, forming soda, alumina, and silica, which are colourless compounds. On the other hand, the elements which form the blue-coloured compound ought to be present in atomistical proportions; and upon 1 atom of sulphur or nitrogen there must be at least 1 atom of sodium or aluminium, silicium or oxygen, supposing there is an excess of these. Now it is well known that ultramarine gelatinises when treated with acids, thereby proving that the silica is really combined with bases. The blue-coloured body must contain, for 1 atom of nitrogen, 1 double atom of aluminium and 1 atom of silicium, but no sodium, otherwise there would not be left a sufficient quantity of basis for the silica of the colourless body, without which (soda) the gelatinising by the action of acids cannot take place. The supposition of the presence of only 1 double atom of aluminium in the blue-coloured body is based upon the fact that the quantity of aluminium found by analysis is not sufficiently large to admit of the presence of 2 double atoms of that element; while, as regards silicium, there can only be 1 atom, since the second atom must of necessity be combined with oxygen, which would otherwise be present in free state, and in order to find elements to combine with the oxygen present, it is evident that it (the O) is to be divided between the sodium, aluminium, and silicium; there remains then, however, a residual quantity of oxygen, which must belong to the blue body, since it is ascertained that that O is not a constituent of an acid of the sulphur or of the nitrogen. Consequently the analysed sample of ultramarine contained 55·7 per cent of silicates of soda and alumina, with a relation of the oxygen in the acids and bases = 2 : 1 and 44·3 per cent of the blue body, $AlSiS_2N_2O_3$; this formula is based upon the following data:—

I first investigated which of the salts present in the well-known mixture employed in the making of ultramarine during the calcination process form, with kaolin, ultramarine blue. I found that neither sulphur, sulphite of soda, hyposulphite of soda, nor mono- or poly-sulphuret of sodium have this effect; but I ascertained that hyposulphite of soda does so when mixed with either carbonate or caustic soda. 1 equivalent of carbonate and 2 equivalents of hyposulphite of soda react upon each other, but the deepest blue is formed when equal equivalents of silica and alumina are applied. The result I obtained by a large number of calcinations with differently made up mixtures proved that the blue body is most copiously formed when the mass to be calcined is compounded according to the following formula:—

$$AlO_3+SiO_2+4Na_2S_2O_3+2Na_2O \text{ or } 2Na_2CO_3.$$

* A criticism of this Article appeared in our last number.

Since, however, the two soda salts are, while being ignited, decomposed in such a manner that half of the sulphur forms sulphate of soda; and since this decomposition begins early in the calcination process, while silicates of soda and alumina are also formed, it is only a relatively small portion of the soda salts which, with the earths, forms blue ultramarine.

The following reasoning convinced me that the formula quoted above for blue ultramarine is correct. Artificially-made ultramarine contains a silicate and a residue $=AlO_3SiS_2N_2O_3$; while, among all the bodies containing sulphur, there is only one which yields, with the aid of carbonate of soda, blue ultramarine, and this of the finest quality and largest quantity, when the mass to be calcined consists of—

$$AlO_3+SiO_2+4Na_2S_2O_3+2Na_2O \text{ or } 2Na_2CO_3.$$

I find that there is then formed $4Na_2SO_4$.* (Some accessory reactions, such as the formation of polysulphuret of sodium, of silicate, &c., do not alter our view, because by these reactions the quantity, not the quality, of the ultramarine-blue is altered.) Since, then, $4Na_2SO_4$ are formed, the residue is $=AlSiNa_4S_4O_3$, which differs from the residue in the finished blue-ultramarine by a *plus* of $2Na_2S$ and a *minus* of N_2. After the washing with water in the presence of air, the calcined mass is first analysed (the analysis of the ignited mass immediately after its removal from the furnace is impracticable, on account of the necessity of working in a vacuum with exclusion of all air), and found to consist of a silicate and of a residue $=AlSiS_2O_5$, formed by the elimination of $2Na_2S$ and absorption of $2O$.

When this washed and dried mass, which is somewhat bluish-green colour, is ignited with chloride of ammonium, the result is the formation of corn-flower (*Carduus benedictus*), blue-coloured ultramarine. The hydrogen of the chloride of ammonium partly forms water and is partly eliminated as gas; the chlorine is found combined with sodium; while the nitrogen combines with the blue-coloured body.

When this calcined, washed, and dried mass is ignited in contact with vapour of sulphur, the original faint bluish-green colour of the calcined mass is retained until it is ignited in contact with air. Again, if the once calcined mass is fused with chlorate of potassa, previous to being ignited with sulphur, the mass retains, after ignition with the last-named substance, its original colour, and only turns blue (becomes ultramarine) when ignited in contact with air. Consequently, in each case a deoxidation precedes the addition of nitrogen.

On comparing the composition of the hardly-coloured body with that of the ultramarine formed from it, or when it is tried to determine the change of weight which the first-named body undergoes by its conversion into the second, the quantity of the fire-proof (*feuerfesten*) materials and the sulphur contained in both is found to be the same. As, therefore, a difference of weight cannot be ascertained with certainty (at least, not at all in preparations which contain about 15 per cent of the blue compound), there only remains the supposition that the oxygen eliminated by reduction weighs nearly as much as the nitrogen taken up, or that an equal number of atoms of the oxygen are exchanged for an equal number of atoms of nitrogen. Although the nitrogen has not been estimated in the sample of ultramarine which I prepared on the small scale, I have no doubt that the blue-coloured body owes its colour as much to nitrogen, as is the case with the ultramarine made on the large scale, a sample of which was analysed by me.

The following formulæ exhibit, beginning with that of the mixture of the dry materials to be made, by calcination, into ultramarine, the various reactions of the process:—

$$\underbrace{AlO_3+SiO_2+4Na_2S_2O_3+2Na_2CO_3}_{\text{Dry mixture to be calcined.}}=$$

$$=\underbrace{AlSO_2+SiSO+2Na_2S+4Na_2SO_4+2CO_2}_{\text{Sulphobasic oxysulphuret, which is removed.}}.$$

Addition to it of 2O from the air=

$$\underbrace{AlSiS_2O_5}_{\text{Ultramarinogen.}}+\underbrace{2Na_2S}_{\text{Which is removed.}}.$$

Addition to it of S as vapour—

$$\underbrace{AlSiS_2O_3}_{\text{Oxysulphuret.}}+\underbrace{SO_2}_{\text{Which is removed.}}.$$

Addition to it of 2N from the air—

$$\underbrace{AlSiS_2O_3N_2}_{\text{Ultramarine.}}.$$

* Found in three calcined mixtures, 49·5, 53·4, 46·7 per cent of sulphur, due to the total quantity of hyposulphites, on an average 49·8 per cent.

ON THE ACTION OF PHOSPHORUS UPON ALKALINE METALLIC SOLUTIONS.

By A. OPPENHEIM.

It is my intention briefly to record here what was *viva voce* communicated to the Society in the earlier part of this year (1872), respecting the researches made by me for the purpose of preparing phosphorus metals (phosphurets) by a new method. There can be no doubt that it is of great importance to obtain such a method, not only because it will enable us thus to prepare new organic phosphines, but, also, because we shall become better acquainted with the metallic phosphines (phosphurets). In the older systems of, and works on, chemistry, the phosphurets are classified with the oxides and sulphurets, as may be seen in Lavoisier's "Traité de Chimie," and in Berzelius's exhaustive work on chemistry. Up to the present day very few metallic phosphines exhibiting a well-defined character and agreeing with our present views of valence (*valenz*) have been obtained. Only rarely and with rather dubious results has the reduction of phosphates been tried for the preparation of the phosphurets, most of which have been prepared, either by the melting together of the elements, or by heating the metals in the vapour of phosphorus. Dr. Schrötter applied the last-named method, and thus obtained a series of incomplete (*unvolkommen*) or non-crystalline compounds, but it was difficult to say whether they really were chemical combinations. Hooslef employed the same method, and also the plan of reducing, by means of charcoal, the oxides of the metals previously mixed with phosphoric acid. He obtained some partly crystalline bodies, the composition of which curiously jars, with one exception, with our views on the trivalence of phosphorus; the formulæ are the following:—

$$Fe''P,\ Fe_3''P,\ Cu_2''P,\ Cu_3''P,\ Zn''P_2, \text{ and } Zn_3''P_2$$

(the only one agreeing with the trivalence of phosphorus). It is clear that by the use of the methods just alluded to there is a danger of mixtures of several different combinations, or so-called alloys, being obtained.

The most ready way to obtain phosphurets—the precipitation of metallic solutions by phosphuretted hydrogen—is of no use, because the precipitation either fails altogether, or is incomplete. It is true that the salts of the noble metals are precipitated, but, as proved by H. Rose, not as phosphurets, but as reduced metals in finely divided state. It might be suggested that, instead of using the hydrogen of the phosphuretted hydrogen as a reducing agent, the phosphorus itself might be so applied; that is to say, whether it would not be possible to obtain phosphurets by heating metallic

solutions with phosphorus. Of course there is a risk, to be avoided as much as possible, of getting with the phosphurets other compounds, such as, for instance, insoluble phosphates, or phosphites and hypophosphites. On this account I operated with metals in alkaline solution, so that any of the phosphorus acids which might happen to be formed should combine with the alkali and not with the metal. I have thus operated with oxide of copper dissolved in ammonia, protoxide of nickel dissolved in ammonia, oxide of lead in potassa, oxide of silver in ammonia, oxide of cadmium in potassa, protoxide of tin in potassa, and oxide of zinc in ammonia. Excepting the two last named, which, even when strongly heated with the phosphorus in sealed tubes, were not acted upon at all, the solutions were heated with phosphorus in excess, and benzol for the purpose of dissolving the phosphorus. The vapours were re-conducted to the flask, in which the operation took place, by means of a condenser vertically connected therewith ; while, by frequent agitation, the contact between the phosphorus and metallic solutions was promoted. I, moreover, took care to occasionally add more ammonia to the solutions containing that liquid.

The tin solution yielded only a white-coloured slimy mass, similar to that which the acids of the phosphorus yield with the oxides of tin, and therefore I did not further investigate these substances.

The solutions of copper, nickel, lead, silver, and cadmium yielded dark-coloured precipitates, which were first washed with water and alcohol, and next with sulphide of carbon, for the purpose of eliminating any excess of phosphorus, after which the substances were dried *in vacuo*.

The deep brown-coloured precipitate obtained from the copper solution was found to be mixed with specks of metallic copper, and yielded by analysis only a small quantity of phosphorus; the bulk of the mass was metallic copper and protoxide of copper. The nickel solution gave a black-coloured precipitate, the composition of which was found to vary in the different samples I prepared. I found for instance—

	1.	2.
P	12·20	12·8
Ni	67·07	66·8

This substance was evidently a mixture of phosphuret of nickel, and the salt of a phosphorus acid akin to that which Dr. Rammelsberg lately obtained while igniting hypophosphite of nickel (See *Ber. d. Deutsch. Chem. Gesells.*, vol. v., p. 495, 1872). The lead solution also yielded a black-coloured precipitate, which was found to contain from 98 to 99 per cent of metallic lead, and about from 0·4 to 0 per cent phosphorus not chemically combined, but only mechanically mixed with the lead, which on being heated in a current of hydrogen did not, while melting, yield any phosphuretted hydrogen. The silver, also, had been precipitated, yielding finely divided grey-coloured metallic silver, which, on being heated in a current of hydrogen, became white coloured (frosty), similar in every respect to the silver obtained by Rose while treating a solution of that metal with phosphuretted hydrogen. I found the samples prepared by me to contain on analysis from 97·39 to 99 per cent of silver. The cadmium solution yielded a light brown-coloured pulverulent precipitate, which, after having been purified as above described, evolved when treated with hydrochloric acid a large quantity of phosphuretted hydrogen ; while when treated with nitric acid it exploded with simultaneous combustion, bursting into flame of the gas which was liberated. I had, therefore, in this instance to deal with a phosphuret of cadmium, but not pure, since the results of the analysis varied greatly in different samples: for instance—

P	17·7	15·03
Cd	76·4	67·00

On being heated in a current of hydrogen this substance yields water (due to an oxygen-containing substance mixed up with the material as an impurity); further, vapour of phosphorus and phosphuretted hydrogen, while there is left a grey-coloured metallic crystalline body, the composition of which corresponds to the formula Cd_3P_2.

	Calculated.	Found.
Cd	84·43	83·98
P	15·57	15·70

The phosphor-cadmium was found not to answer for the purpose of double decomposition in organic substances (iodide of ethyl, sulphide of ethyl). Herr E. Schatz has greatly assisted me in these researches.—*Ber. d. Deutsch. Chem. Gesells.*

ON THE

ESTIMATION OF SULPHUR IN COAL AND ORGANIC COMPOUNDS.

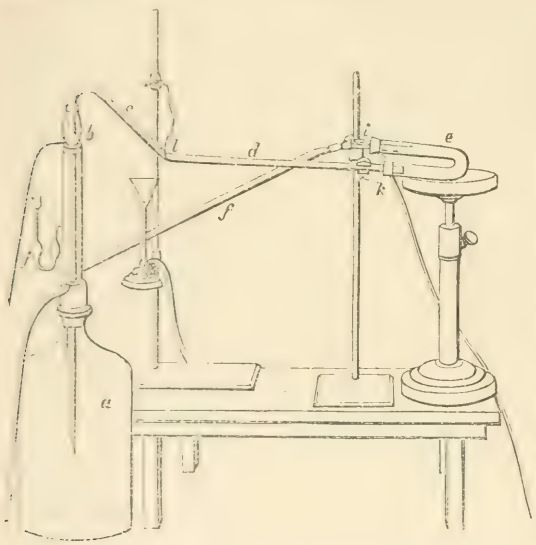
By W. G. MIXTER.

THE determination of sulphur in organic substances by many of the methods in use is not only a difficult and tedious operation, but the amount of fixed reagents often employed greatly increases the liability to error. In the process here described, substances are burned in oxygen, and the sulphur is condensed from the gaseous products in the form of sulphuric acid.

Experiments made by passing the products of combustion of sulphur compounds through nitric acid failed to give satisfactory results. A variable loss was due to a dense white fume containing sulphuric acid, which was not completely absorbed by water or by caustic alkalies. The apparatus here described was designed for making the combustions in a confined volume of gas, to avoid this source of error. The bottle, *a* (see figure), has a capacity of from 4 to 10 litres, according to the amount of oxygen required. The neck should be large enough for a stopper 35 to 40 m.m. in diameter. The condenser, *b*, is made of rather thin tubing, 14 m.m. in diameter; at the upper end it is expanded to a bulb, in order to admit some motion to the tube *cd*. Below the bulb it is surrounded by a water-jacket 22 c.m. high; from the point where it enters the stopper of the bottle it is narrowed somewhat for convenience of fitting. The combustion-tube *cd* is made of hard glass of 12 to 15 m.m. internal diameter; the portion *c* is 18 c.m. from curve to curve, and is protected by a sheet-iron trough lined with asbestos; the part *d* is from 35 to 45 c.m. in length. The wire attached at *l* is to sustain *c* in case *d* breaks; *c* is joined to *b* by a collar of black rubber. The U-tube *e* is connected with *d* by a rubber collar drawn over the latter at *k*; this U-tube is slightly inclined, that no liquid may run against the rubber connectors. The tube *f* connects *a* with *e*; it is narrowed at both ends to 10 m.m. diameter. Near the upper end it is jointed by a piece of black rubber tubing in order that the apparatus may be easily disconnected at *k*. The ends of *f* extend 2 c.m. or more beyond the stoppers. Through the rubber stopper, *i*, a small glass tube passes beyond the end of *f*, where it is narrowed to an opening of 1 m.m. The double-bulb tube, *j*, is to accomodate variations of pressure, and to admit air as the original volume of gas diminishes during the combustion. The tubes *b*, *c*, *d*, and *f* should at no point have an internal diameter less than 8 m.m.—10 m.m. is preferable—and the narrowed ends should be cut obliquely that drops of water may not obstruct the circulation. The rubber stoppers and connections should be freed from adhering sulphur by heating in a solution of sodium hydrate. The joints of the apparatus are sufficiently tight when water will stand in one limb of the safety-tube.

The bottle, *a*, is filled over water with oxygen, and, if necessary, rinsed with distilled water a few drops of

bromine are poured in, the tubes adjusted, and a slow stream of water made to flow through the water-jacket. The assay, if not volatile, is introduced into the tube *d* in a platinum tray,* which should not fill more than half the bore of *d*, leaving space enough for the free circulation of the oxygen. The part *c* is gradually heated, and kept hot during the combustion. This hot inclined tube acts as a chimney; the heated gases rise in it, pass into the cold tube *b*, and fall, thus causing a constant stream of gas to pass over the assay. It is important to ignite the assay without distilling off any considerable portion. To do this a small splinter of wood may be placed in contact with that part of the substance nearest *l*, or that end of the tray may hold a thin layer of the assay, which is heated as rapidly as safety allows by a lamp held in the hand. To ensure a full supply of gas in the tube *d* at the commencement of the combustion, oxygen is passed from a gasometer through the tube *i* till the white fume which appears in the condenser, *b*, passes into *a*. The products of combustion, being denser, fall to the bottom of the bottle, and for a while displace the oxygen, thus increasing the circulation. After the substance is ignited, the fire passes to the other end of the tray. The part of the tube about the tray is heated by a lamp which is required to keep



up the combustion. At the end of the operation the heat is increased. If drops of liquid collect in *c*, and are liable to run down to the hotter parts of the tube, they should be driven off by heat. If carbonic acid be the principal product of the combustion, there is little change in the volume of gases in the apparatus; but if water and sulphuric acid are formed in much quantity, the volume is diminished, and air enters through the safety-tube.

Most solid substances heated alone in the open tray yield volatile products too rapidly for entire combustion, but if mixed with sand in suitable proportion they burn slowly and completely. Liquids should be enclosed in narrow tubes sealed at one end and drawn out at the other to a capillary bore for 2 or 3 inches of length. Upon the point of the tube a bit of platinum sponge is fixed to assist the oxidation. The liquid should not fill more than two-thirds of the wider part of the tube.

Before introducing very volatile substances, the 10 c.m. of the combustion-tube *ld* should be heated to dull redness. Oxygen is passed in at *i*, the tubes are disjointed at *k*, and the tube holding the assay is then pushed in till the platinum just reaches the heated zone. The apparatus being connected at *k*, slow volatilisation of the liquid is effected by cautiously applying a flame under the empty portion of the tube containing the substance, so as to maintain the platinum-sponge in a steady glow. As soon as a cloud of combustion-products appears in the vessel, *a*, oxygen is shut off from *i*. When all the liquid has distilled from the interior tube, the tube *cd* is cooled slowly, and the apparatus is left for two hours, or until the fume has entirely subsided. If no odour of bromine be perceptible when the apparatus is disconnected at *k* to remove the tray or tube, a few drops of it should be poured through a funnel-tube put in the place of *j*, and the whole allowed to stand some time, to ensure complete oxidation of the sulphur compounds and deposition of the sulphuric acid.

The tubes *d* and *e* are then rinsed into a beaker; this water is poured into *b*, which is then thoroughly washed by the aid of the wash-bottle. The large rubber stopper is lifted from the bottle, and the lower part of *b* rinsed; without removing the tube *f* from the stopper, it is rinsed into a beaker, and, finally, the bottle is carefully washed. The solution obtained, which need not exceed 500 c.c., is evaporated to a small volume, filtered, if necessary, and the sulphuric acid precipitated by barium chloride. The barium sulphate washes easily, as the solution contains no nitrates or fixed salts; its purity is ascertained by treatment with water and a few drops of chlorhydric acid, warming some time, filtering, and re-weighing. In case the substance leaves an ash or residue in the tray, this must be dissolved in aqua regia, the nitric acid removed by evaporation with strong chlorhydric acid, and any sulphuric acid it may contain separated in the usual manner. In the use of this apparatus there is no danger from explosions, if care be taken to have the combustion-tube hot enough to ignite combustible vapour. Before attempting to burn a substance in the apparatus, it is best to try it in a large inclined tube open at both ends, or with oxygen supplied at the lower end. Such a preliminary trial will usually indicate the precautions necessary in burning the substance in the apparatus.

The writer found that when oxygen prepared from a mixture of potassium chlorate and manganese dioxide, or from the chlorate alone (no rubber stoppers or connections being employed), stood some time in a bottle containing a few drops of bromine and a little water, the water gave a slight turbidity with barium chloride. Neither the bromine nor the solution of the chlorate gave reactions for sulphuric acid; the manganese dioxide contained, however, a trace of sulphur. Combustions of alcohol and of sugar-charcoal, made by the method here described, yielded with barium chloride a precipitate apparently no greater than that obtained from the oxygen alone, and too slight to influence ordinary results. This shows that, with suitable care, rubber stoppers are not objectionable.

The following results, obtained in the order they are given, show the applicability of the method, while some of the details mentioned may help to explain the use of the apparatus:—

	Weight Taken.	Per cent Found.
1. Iron pyrites (mixed with carbon) ..	0·0658	51·20
2. ,, ,, ...	0·0597	51·26
3. Sulphur	0·2070	99·76
4. ,, ...	0·2807	99·92
5. ,, ...	0·4951	99·93
6. ,, ...	0·5882	100·02
7. Carbon disulphide	0·7725	84·12
8. ,, ,, ...	0·4598	84·16
9. Bituminous coal	0·6640	2·97
10. ,, ,, ...	0·7860	2·99
11. Wool	0·4640	3·44
12. ,, ...	0·4675	3·46
13. Tobacco	2·0720	0·37
14. ,, ...	2·1370	0·36

9 litres of oxygen were used in Nos. 1, 2, 13, and 14 and 4 litres in each of the other analyses.

* A platinum tray which answers well may be made 10 to 20 c.m. long, 10 m.m. wide, and 7 to 10 m.m. deep, by bending thin foil over a glass tube. The ends may be roughly bent together or left open.

In No. 1 the iron pyrites was mixed with 1·3 grs., and in No. 2 with 2 grs. of sugar-charcoal, and the residues remaining after the first combustion were mingled with a small additional portion of charcoal, and the combustion repeated to remove the last traces of sulphur. The solutions of the final residues in aqua regia, after evaporation nearly to dryness to expel the excess of acid, gave no turbidity with barium chloride. The sulphur in this pyrites was estimated by another method by way of control.* This mixture of pyrites with charcoal was used as an imitation of coal, which should contain a known amount of sulphur.

The sulphur used in Nos. 3, 4, 5, and 6 was purified by crystallisation from carbon disulphide solution, and fused. It was placed in a narrow weighed glass tube from 5 to 7 c.m. long, boiled, allowed to cool, and the whole weighed. During the combustion of No. 4, the sulphur volatilised so rapidly at one time that a portion escaped unburned, and formed a coating in the neck of the combustion-tube and in the condenser, which soon disappeared, probably oxidised by the action of sulphuric acid and bromine.

The carbon disulphide was the commercial article, purified by distillation from calcium chloride and quicklime. The boiling-point was constant. The per cent of sulphur calculated is 84·21. On account of its volatility and resistance to the action of bromine, it required more care in its combustion than pure sulphur. It was weighed in a sealed tube having a neck 3 inches long with a very fine bore. The end of this neck was broken off, and the open point was thrust into a cylinder of platinum-sponge wrapped in foil, and the whole was quickly placed in the combustion-tube as has been described.

The powdered bituminous coal was burned in a tray. In No. 10 some tarry matter passed into the condenser. No sulphur was found in the reddish ash, which amounted to 5·57 and 5·22 per cents.

The wool was from South Down sheep. It was purified by washing with soap, and afterward with ether, and was dried at 212°. Wool swells so by heat that it cannot conveniently be burned in an open tray. No. 11 was contained in a glass tube sealed at one end. After the volatile matters had been burned off, the tube was taken from the apparatus, the closed end was broken, and the charred residue mostly transferred to a tray, which, together with the tube, was returned to the combustion-tube to complete the oxidation. In No. 12 a small platinum tube, extemporised from foil, closed at one end by a glass plug, was employed.

The pulverised tobacco of No. 13 was burned in an open tray, and the combustion occupied less than five minutes. A small amount of hydrocarbons passed over unconsumed, and, owing to the intense heat, a white sublimate formed above and beyond the tray. No. 14 (same tobacco) was mixed and covered with sand; the combustion lasted twenty minutes, and the oxidation was complete. The ash of the tobacco retained by far the larger part of the sulphur. In No. 13, 0·11, and in No. 14 0·03, per cent of sulphur was obtained from the gaseous products. Mr. E. S. Breidenbaugh found in the same sample, by Reichhardt's method,* 0·36 per cent.

It is plain that the sulphuric acid of the gaseous products is obtained by this process under conditions highly favourable for its exact estimation. The solution from which it is precipitated contains no fixed salts and no nitric acid, the presence of which renders the barium sulphate difficult to purify, but only sulphuric and bromhydric acids. The only impurities that can attach to the barium sulphate are accordingly barium chloride and bromide. The former may be perfectly removed by warming the ignited precipitate with dilute chlorhydric acid, as Fresenius has conclusively shown in a late paper.† This method of purifying the barium sulphate has also the sanction of Bunsen.‡ It is not probable that barium bromide would resist treatment which removes the chloride. In the analyses given, the writer added barium chloride slowly to the concentrated boiling solution, and after twelve hours or more decanted the supernatant liquid, boiled the precipitate with two or more portions of water, and washed with hot water till sulphuric acid gave no turbidity in the washings. The precipitate washed rapidly, and an hour to an hour and a half generally sufficed for the largest ones. In purifying the larger precipitates, they were placed in a beaker with from 50 to 100 c.c. of water and a few drops of acid. Any lumps were broken up by a rod, and the whole was boiled half an hour or more. The smaller precipitates were treated in the crucibles. In all cases the purifying was continued till sulphuric acid gave no reaction for barium salts in the last filtrate. The precipitates, weighing from 2 to 4 grs., lost, by digesting with dilute chlorhydric acid, from 0·007 to 0·020 gr.

To Professors Johnson and Allen I desire to return thanks for their assistance and for many valuable suggestions.—*Am. Journ. Sci.*

* The analyses of pyrites were mostly made by a modification of the method of Storer and Pearson (*Am. Journ. Sci.*, xlviii., 190). The pulverised iron pyrites (0·2 to 0·5 grm.) was mixed with three its bulk of powdered potassium chlorate; about 25 c.c. nitric acid, sp. gr. 1·1, were then added to the mixed powders, and the whole was heated cautiously, but not to boiling, for fear of melting the sulphur which separated. A complete solution was obtained in five to ten minutes; it was evaporated to dryness, and the evaporation twice repeated with the addition of chlorhydric acid. The barium sulphate was finally precipitated from the solution containing but a few drops of free acid. It was washed first by decantation with water, was then digested with three separate portions of ammonium acetate, and the washing was continued with water till sulphuric acid gave no turbidity in the washings. These precipitates, after ignition, yielded no barium salts to hot dilute chlorhydric acid; they were slightly reddish in colour, and the sulphur calculated from their weight amounted to 51·69 and 51·73 per cent respectively. In two other determinations, potassium-sodium tartrate (no pure tartaric acid being at hand) and chlorhydric acid were added to the solutions before precipitating, with the hope of retaining the iron in solution more perfectly; the barium sulphate was treated as above described. The precipitates had, notwithstanding, a reddish colour, and corresponded to 51·78 and 51·76 per cent of sulphur respectively. They yielded nothing to dilute chlorhydric acid, and were accordingly free from adhering barium salts. They were, according to the suggestion of Mitscherlich (*Journ. f. Prakt. Chem.*, 83, 456), dissolved in strong sulphuric acid, thrown down by water, washed, and again weighed. They were now free from iron, and corresponded to 51·28 and 51·40 per cent of sulphur respectively. In another estimation, the barium sulphate, which contained a large amount of ferric oxide, was slightly washed with water, then fused with sodium carbonate, extracted with water, and the sulphuric acid thrown down from the aqueous solution after addition of a slight excess of chlorhydric acid. The barium sulphate, thus obtained free from iron, was digested with ammonium acetate, and finally washed with water. The sulphur calculated from it was 51·27 per cent. The latter plan of purifying barium sulphate has long been employed by Prof. O. D. Allen in the analysis of iron ores, and its publication was made nearly simultaneously in the American edition of Fresenius's "Quantitative Analysis," p. 525, from notes furnished by Prof. Allen, and in a paper by Fresenius in his *Zeitschrift*, x., 52.

* Caldwell's "Agricultural Qualitative and Quantitative Analysis," p. 246.

† *Zeit. f. Anal. Chem.*, Bd. ix., s. 52.

‡ *Ibid.*, Bd. x., s. 396.

PROCEEDINGS OF SOCIETIES.

GLASGOW PHILOSOPHICAL SOCIETY.

(CHEMICAL SECTION).

Ordinary Meeting, January 15th, 1873.

DR. WALLACE, F.R.S.E., President, in the Chair.

"*On the Composition of some Zeolites*," by J. WALLACE YOUNG.

The term zeolite is applied to a class of minerals consisting essentially of silica, alumina, water, and some alkali or alkaline earth. As they occur more or less abundantly in all the older trappean rocks, they have been, perhaps, better examined than many other minerals, and it might therefore appear a little out of place on my part going over such well-trodden ground. The principal object

I had in view, however, was the correct determination of the alkalies present, which, by the older methods, was tedious and often unsatisfactory, but which the excellent process of Professor Lawrence Smith enables us to do with the utmost ease and accuracy. The examination of the alkaline residues spectroscopically was also essentially necessary. The determination of the various constituents was carried out according to the methods given by Fresenius.

In testing the residual silicic acid by boiling with sodium carbonate solution, a great deal of trouble was experienced frequently by its sparing solubility in that reagent. I have not as yet been able to find out why the silicic acid should be quite soluble in some cases and not so in others, when subsequent examination showed it to be equally pure in both cases. For instance, in one specimen of analcime, which had been decomposed with hydrochloric acid, the silicic acid was almost insoluble in sodium carbonate solution; prolonged boiling and using different proportions of water, &c., did not seem to have any effect. On being fused with alkaline carbonate, and separating as usual, it was found to be pure, and was now quite soluble in the sodium carbonate solution.

Another specimen of analcime decomposed by acid gave 55·56 per cent of silicic acid, very sparingly soluble; a fresh portion of the mineral, fused with alkaline carbonate, gave 55·52 per cent of silicic acid, which dissolved in sodium carbonate and gave a clear solution. The difference of time and intensity of heat employed in the ignition of the silicic acid did not seem to affect its solubility. The occasional sparing solubility of silicic acid comes to be of great importance in an analysis of mixed silicates only partially soluble in acids, when, after the acid treatment, the residue is boiled in sodium carbonate solution to extract the separated silicic acid, washed and dried, and the insoluble silicates fused with alkaline carbonate as usual. The silicic acid would be apt to come out too low for the soluble silicates, and too high for the insoluble ones.

Analcime.

	(1).	(2).	(3).
Specific gravity ..	2·153	2·271	2·259
Silicic acid	54·85	54·48	55·54
Alumina	22·59	23·01	22·27
Lime	0·89	—	—
Soda	12·58	14·00	13·75
Water	9·06	8·28	8·55
	99·97	99·77	100·11

No. 1., from vein, Crofthead, Renfrewshire.—The sides of the vein have been first coated with a lime zeolite, probably Thomsonite, the interior having been then filled with analcime. Specimen carefully picked. The alkali consisted solely of soda.

No. 2, from Mugdock Water Tunnel.—Alkali, soda only.

No. 3, Boylstone Quarry, Barrhead.—Alkali, soda only.

Every constituent was at least determined twice. These figures agree fairly with the formula accepted for analcime, $Na_2O,Al_2O_3,Si_4O_8+2Aq$. According to Dr. Odling's arrangement, analcime is a meta-silicate of the spinelle series, in which the ratio of the oxygen of the bases to the oxygen of the silicic acid is as 1 to 2.

Thomsonite.

From the *débris* taken out in blasting the Loch Katrine Water Tunnel, Mugdock.

	Sp. gr., 2·380.
Silicic acid	36·84
Alumina	31·57
Lime	13·54
Soda	4·31
Water	13·54
	99·80

Alkali, soda only. Agrees with the formula given by Dana, $(Na_2Ca'')O_3 + Al_6O_9,Si_6O_{12} + 7Aq$. An ortho-silicate in which the ratio of the oxygen of the bases to the oxygen of the silicic acid is as 1 to 1.

Natrolite.

From Loch Thom, near Greenock.

Silicic acid	46·29
Alumina	27·10
Soda	15·37
Lime	0·72
Water	10·43
	99·91

Alkali, soda only. The formula is—

$$Na_2O,Al_2O_3.3SiO_2+2aq.$$

A para-silicate, in which the oxygen of the bases is to the oxygen of the silicic acid as 2 to 3.

Stilbite.

From Long Craig, Dumbartonshire. Slight reddish colour. Splinters of this mineral parallel with cleavage planes show very fine colours in polarised light.

	Sp. gr., 2·167.
Silicic acid	57·82
Alumina (containing a little Fe_2O_3)	15·30
Lime	8·12
Soda	0·83
Water..	17·85
	99·92

Agrees pretty well with the formula—

$$CaO.Al_2O_3 6SiO_2+6Aq.$$

Alkali, soda, with a trace of potash. A sesqui-silicate, the oxygen being as 1 to 3.

Prehnite.

From Bowling, Dumbartonshire.

	Sp. gr., 2·885.
Silicic acid	43·41
Alumina	24·77
Lime	27·13
Soda	0·27
Water	4·20
	99·78

Formula, $2CaO,Al_2O_3 2SiO_2+Aq$.

The alkali has been all calculated as soda, but the spectroscope showed lithia distinctly, as also a trace of potash. Every care was taken as to the purity of the chemicals; but, in fact, the carbonate of lime used in the determination of the alkalies was all taken from the same supply. Some of the rock matrix adjoining the mineral was examined, and lithia likewise detected. Two other specimens of rock from near the same locality showed lithia likewise. A specimen of prehnite from Barrhead did not show any lithia.

Dr. WALLACE said the subject treated of by Mr. Young had been studied by various chemists, of whom Dr. Odling had carefully classified the zeolites. Smith's process was very useful where the amount of alkali was very small, as in fire-clays, and hence it was most likely to come into general use.

"*On the Decomposition of Sulphate of Potash by Nitrate of Soda*, by WILLIAM HENDERSON.

Starting with the assumption that nitrate of potash or nitrate of soda had the power of increasing the solubility of some salts, such as those that are found mixed with them in a crude state—the alkaline sulphates and chlorides—the author, a number of years ago, made some efforts to produce saltpetre from Canadian potashes and nitrate of soda. One of his earliest notes was to the effect that, if nitrate of soda dissolved an increased quantity of sulphate of potash, nitrate of potash might crystallise from

the solution, or decomposition might take place under pressure. After referring to the order of crystallisation of the salts from kelp liquor, the author stated that the experiments were continued, and although there was from 12 to 15 per cent of sulphate of potash in the potashes, or 6 to 8 per cent in the whole materials used, there seemed no indication of saltpetre collecting in the liquors in any marked quantity, or in the residual salts; and it was supposed to be lost in the residual salts, and although found in these, it was not in sufficient quantity to account for the whole. It was then suspected that it was decomposed by the nitrate of soda; and to prove this, equivalents of nitrate of soda and sulphate of potash were dissolved together, and then evaporated till a slight pellicle formed on the surface. The solution was allowed to crystallise for some days, sulphate of soda being found in the crystals, but no saltpetre crystallised until the mother-liquor was evaporated. The following memorandum was made at the time, viz., "that the decomposition might be made perfect, but the conditions under which this may be effected are peculiar." The probable peculiar conditions were sought for, such as some special density of the solution, some stage to which the solution should be "salted" down, or particular temperature at which the liquid should be kept until crystallised. Many trials were made with liquids of varying densities, weak solutions were allowed to evaporate spontaneously, the solution of one salt was gradually added to the other while being evaporated, and then the contrary, but no satisfactory result could be obtained. The experiments were suspended for about two years, and then resumed, and the author was led to the conclusion that there must be something to induce the decomposition desired. Thinking that a larger quantity than an equivalent weight of nitrate of soda might be necessary, he used a double quantity of that salt along with sulphate of potash. The solution was boiled until a quantity of saline matter was thrown down, the clear liquor yielding, in a separate basin, nitrate of potash crystals very readily; and the boiled-down salt was dissolved and gave a distinct crop of sulphate of soda crystals. It thus seemed that only an excess of nitrate of soda was required to begin decomposition, and that the boiling down process would complete it. Quantities of half a ton were then used, keeping the nitrate of soda in excess; but when about two tons of the materials were in process, the operation proved a failure, no decent crop of crude saltpetre being obtained, but, instead, a mixture of sulphate of potash and sulphate of soda thrown down together by the boiling; and instead of getting crystals of saltpetre, there was a mixture of sulphates and nitrates of potash and soda. Referring to the fact that Leblanc's soda process was only successful when lime was used in more than the theoretical quantity, the author said that the idea that the same condition was wanted in the case of the sulphate of potash presented itself; that it was not a slight excess, but a double equivalent, that was *absolutely* necessary. By subsequent experiments, this was fully demonstrated, and sulphate of soda and saltpetre were obtained of excellent quality.

On the suggestion of Mr. Tatlock, the Secretary of the Section, Mr. HENDERSON tried an equivalent of chloride of sodium instead of the second equivalent of nitrate of soda, and the mixture, on being salted down, was quite successful in yielding a good crop of sulphate of soda, and afterwards nitrate of potash. Mr. Tatlock had noticed, when studying the saltpetre process at Kames gunpowder mills, that, although sulphate of potash was present in small quantity in the muriates used, instead of sulphate appearing, it was always chloride of potassium, while the sulphate of potash was decomposed by the common salt. The decomposition of the sulphate of potash suggested the idea that the more valuable carbonate of potash might be made in the same way from muriate of potash. This was found to be unsuccessful in practice. An experiment was also tried with caustic soda, instead of any of the salts named; double decomposition only took place when the base having the highest equivalent number was separated from the acid having the highest equivalent number. In conclusion, Mr. Henderson said he could not believe that Leblanc's soda process and his own sulphate of potash process were the only instances of such anomalous decompositions as he had referred to, where more than the theoretical quantities of the compounds used were required; and he desired to elicit from the Members whether or not they knew of any similar peculiarity.

Mr. PATTERSON said he had thought of the process which had been described, but he had gone direct to the kelp liquor with the nitrate of soda, which he had used in slight excess. Large quantities of saltpetre had been made by the process, and the iodine was afterwards obtained in the usual way from the mother-liquor. He had found the temperature had something to do with the order of the decomposition.

Dr. WALLACE considered that both temperature and the relative solubilities of the salts used were involved in the successful results of the process.

NOTICES OF BOOKS.

British Metric System. By ISAAC GREGORY. London: Cassell, Petter, and Galpin. Paris: Hachette et Cie.

THE exposition of an ingenious attempt to reconcile the present British weights and measures with the metric system and to pave the way for the introduction of the latter. The author points out that with slight modifications the imperial pound, foot, quart, &c., might be made to rank as members of a metric series. Thus the modified pound would be the half kilogramme, and would be divided into 20 ozs. of 25 grammes each. Its multiples would be the metric stone of 10 lbs., the metric cwt. of 10 stones, and the metric ton of 20 cwts. In this manner he maintains, the public, on the introduction of the new system, would not be left in ignorance of the fair prices of commodities as compared with the old standard. His metric foot differs from the present foot by the $\frac{1}{8}$th part of the present inch. He divides it into 12 metric inches, each of which is equal to $2\frac{1}{2}$ centimetres or 25 millimetres. His metric yard consists of 40 metric inches. He urges that the metric inch, "differing only by about a hair's breadth from the old inch, even tailor's registered measurements, supposed to be the most precise in all non-technical trades, would not suffer. The sizes of paper, books, and engravings would not differ appreciably. The standards for small parts of machines will not differ in quotations by the metric inch."

The objections to the present British system and to the introduction of the metric system, "*pure simple*," as it exists in France, are plainly and lucidly stated in the form of a catechism at the end of the work.

Our readers, many of whom use the metric weights and measures in their scientific investigations will doubtless wish the author good speed in his undertaking. It is much to be regretted that the question of reform in our weights and measures has been made a matter of party-politics; attempts to familiarise the children in our national schools with the decimal system having been officially denounced in Conservative organs.

The Owens College Junior Course of Practical Chemistry. By H. E. ROSCOE, F.R.S., and F. JONES. London: Macmillan and Co.

A COMPACT and well arranged manual for experimental study, intended, as we learn from the preface, "not to supplant, but rather to supplement, instruction given by the teacher." There is a clear sketch of the most important blowpipe tests, including Bunsen's flame reactions; next follow tables for the detection and separation of the elementary bodies. We notice with pleasure that

the characteristic reactions of the rarer substances, such as indium, rubidium, and thallium are not omitted. There is also a section on the recognition of the most important and best-characterised organic compounds, such as the vegetable acids, the alkaloids, albumen, starch, sugar, &c.

The work closes with a section of "Questions and Exercises," well devised for enabling the student to test his own progress. The general merit of this little volume makes us regret the more that so large a part of its bulk is occupied with the publishers' catalogue, a kind of addition which we strongly deprecate.

Alizarine, Natural and Artificial. By Fred. Versmann, Ph.D. New York.

This pamphlet, after some needless remarks on the history of the gas manufacture, gives an account of the cultivation of madder. The author tells us, very truly, that the colours obtained from Dutch madder are not fast, and that the "paluds" is the finest French quality. We have next an account of the various commercial preparations of madder, *fleur de garance*, garancine, green alizarine, and extract of madder. Then follows a chapter on the properties, purification, and testing of anthracene, the raw material from which artificial alizarine is obtained. The preparation of the colour is given in detail, together with the proofs of its absolute identity with natural alizarine as obtained from madder. It is interesting that the author pronounces artificial alizarine superior and preferable to the natural from madder, as the latter invariably contains impurities which deteriorate the colours and dirty the white ground of the cloth in printing.

The following passages have, for us, a painful interest:—"England produces immense quantities of benzole, the greatest part of which goes to Germany, there to be converted into aniline dyes, a considerable quantity of which goes back again to England. No other country is so far advanced in the manufacture of the coal-tar colours as Germany. The quantity of alizarine manufactured by the German makers far surpasses the English production." That we should have to import coal-tar colours from any country seems to us nothing less than a national disgrace.

The theoretical yield of alizarine is calculated by the author at one for every 1000 tons of coal converted into gas. Practically it does not exceed half this amount.

The pamphlet concludes with some valuable recipes for printing with artificial alizarine, and for preparing the requisite thickeners and mordants.

Traites des Dérivés de la Houille Applicables a la Production des Matieres Colarantes. Par MM. C. Girard et G. de Laire. Paris: Masson. London: Williams and Norgate.

The important part played by the coal-tar products in modern industry is well evinced by the number and scope of the works devoted to their consideration. The treatise before us must be pronounced a valuable contribution to this branch of chemical technology. The authors are well known to possess an extensive and thoroughly practical acquaintance with the manufacture of aniline colours. Commencing with an enumeration of the bodies produced by the destructive distillation of coal, they take up in detail each one applicable to the preparation of tinctorial substances, and give a full account of its composition, preparation, decompositions, and combinations. Those products which have become of commercial importance are treated at great length; their preparation and purification being described in full detail according to the most improved methods. Diagrams of the needful plant and machinery have been added, carefully drawn to scale. The separation and utilisation of the various residues—a most important point in the manufacture of aniline colours—has not been overlooked. The authors have very judiciously called especial attention to imperfectly known bodies, whose further investigation is likely to prove of interest, theoretical or practical.

Those best acquainted with the wonderful fecundity of organic chemistry will be least surprised to learn that, despite the researches of so many eminent men, such substances are by no means few. The interesting researches of Krouber are given in detail. This chemist, taking eleven kinds of benzine, of which the boiling-points and specific gravities were noted, transformed them successively into nitrobenzines, anilines and magentas, the amount and quality of the yield being in each case registered. It is by such investigations that the manufacture of coal-tar colours will be freed from empiricism and placed on a rational footing.

The preparation of safranine, geranosine, rosanaphthylamine, and other of the recent colours is described. Artificial alizarine, as obtained from anthracene, is omitted. The treatise, it must be remembered, is addressed to the colour-maker rather than to the dyer and printer. Hence prescriptions for the uses of the various colours will not be found in its pages. To all connected with the manufacture of coal-tar products it will prove a most valuable book of reference.

Mikroskopische Untersuchungen der Gespinnst-fasern, &c. Von Dr. R. Schlesinger. Zurich: Orell, Fuessli, and Co.

This work embodies in brief space the results of valuable and prolonged research on the recognition of the fibres met with in commerce. The microscopical and chemical characteristics of each kind employed in textile manufactures are given first in its raw state. The author's tests are sulphuric, nitric, and chromic acids, alcoholic solution of iodine, cuprate of ammonia, dilute potassic hydrate, and sulphate of aniline, the latter to indicate lignification of the fibre. The examination under polarised light is recommended both for vegetable fibres and varieties of silk. Wool, silk, cotton, and linen are next examined when dyed and printed. The reagents recommended are iodine, chromic acid and dilute sulphuric acid, hydrate of soda and cuprate of ammonia, which the author prefers to prepare by dissolving metallic copper in strong liquid ammonia.

The last section is devoted to the detection of shoddy when mixed with fresh materials. The author points out as its characteristics the frequent absence of the scales found upon the fibres of fresh wool, the irregular diameter of the hairs, and their worn and jagged appearance. Shoddy swells up and dissolves in alkaline lye more readily than new wool.

We cannot help expressing our regret that England, the very focus of textile manufactures, must be indebted for such researches to the Continent. The pursuit of abstract truth, much sneered at by our manufacturers, is found abroad to draw after it, in the words of Bacon, "whole squadrons" of valuable practical results.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, January 20, 1873.

This number opens with the record of the death, on the 18th inst., at Paris, of Baron Charles Dupin, one of the oldest members of the Academy, at the age of 89 years. The deceased has been a member of the Academy since 1818, and was a celebrated physicist and mathematician. The following original papers and memoirs more particularly relating to chemistry are published in this number:—

New Derivatives from Propyl.—A. Cahours.—After first referring to the labours of Chaucel, Pierre, Puchot, and others on propyl, the author describes at length the results of his researches on Sulphuret of propyl, an oil-like fluid, lighter than water, exhibiting a fœtid odour; sp. gr. at 17° = 0·814; boiling-point, from 130° to 135°. This sulphuret yields, when treated with iodide of propyl and some water in a closed vessel, a new body, the formula of which is—

$$C_{18}H_{21}IS_2 = \left(\begin{matrix} C_6H_7 \\ C_6H_7 \\ C_6H_7 \end{matrix}\right)I.$$

Quicksilver propyl is a colourless, mobile fluid; exhibits hardly any smell when cold, but a penetrating smell on being heated; insoluble in water; soluble in ether, and somewhat in alcohol; sp. gr. at 17° = 2·124; boiling-point, between 189° and 191°; formula, $Hg(C_6H_7)_2$. Iodide of tri-stanno-propyl, $Sn(C_6H_7)_3I$, boils at about 270°; sp. gr. at 16° = 1·692; a colourless liquid which has an irritating effect when poured upon the skin; it forms a hydrated oxide, $Sn(C_6H_7)_3O,HO$, when treated with caustic potassa solution, and the hydrate becomes anhydrous by distillation over caustic baryta. Nitro-propan, $C_6H_7(NO_4)$, is also a liquid; boiling-point, between 125° and 128°; under the influence of nascent hydrogen, this body is converted into propylamine. Nitropropan combines with soda, forming a solid crystalline compound, $C_6H_6NaNO_4$.

Apparent Substitution of Metals for themselves (à eux mêmes) in their Saline Solutions.—F. M. Raoult.—When a cadmium wire is wound spirally on a small plate of gold, and immersed into a boiling and concentrated solution of sulphate of cadmium, that solution is rapidly decomposed, and there is deposited on the gold a firmly-adhering film of cadmium. Chloride of cadmium may be substituted for the sulphate, but the experiment does not succeed with the nitrate. When, instead of a cadmium wire and cadmium solutions, zinc wire and solutions of either sulphate or chloride of zinc are applied, a similar result obtains, zinc being deposited upon the gold; the same obtains when tinfoil is wound round the gold, and the metals immersed in a concentrated and boiling-hot solution of protochloride of tin. Instead of gold, copper may be used; but with gold and iron, nickel, antimony, lead, copper, and silver, such phenomena do not take place. The metals deposited on the gold form with it true alloys, which can only be destroyed by continued boiling with acids.

Some Compounds in which Phosphorus appears to Exist in a Condition Analogous to that of Amorphous Phosphorus.—A. Gautier.—This paper treats at great length on the results of the decomposition of bi-iodide of phosphorus by water in excess. In addition to phosphorous and hypophosphorous acid, there is formed a new body, Ph_5H_3O, a solid substance which is readily converted into phosphorous and phosphoric acids.

Bayerisches Industrie und Gewerbe-Blatt, December, 1872.

Preparation of a Strongly-Decolourising Animal Charcoal.—Dr. Graeger.—The common powdered bone-black is first mixed with from four to six times its bulk of a solution of from 4 to 5 per cent of crystallised carbonate of soda, and boiled therewith for some time; next it is washed by decantation, and, after that, treated with a large excess of dilute hydrochloric acid, sufficient, not only to dissolve the carbonate, but also the phosphate of lime it contains. (In order to see whether enough acid had been added, a small sample of the previously-filtered fluid is tested by means of ammonia, which, when added in slight excess, should not produce a turbidity.) When the mineral matter is removed, the charcoal is thoroughly washed, first by decantation, and next placed on a filter and washed until the water exhibits no acid reaction; the material is then carefully dried at from 100° to 120°. 100 parts of crude animal charcoal yield 20 of the purified, which has highly decolourising properties. The method requires time and patience.

Preparation of an Indelible Ink for Marking Linen and Cotton Fabrics.—Dr. Bottger.—It appears that the juice of the Anacardium nut (*Anacardium orientale*) contains an oily matter, which, by exposure to air, gradually assumes an intense black colour; this colour is neither acted upon by acids, alkalies, chlorine, or cyanide of potassium. The previously pulverised nut is treated in a closed glass vessel with petroleum ether (benzoline), and, having been digested therewith for some time, the fluid is left exposed to air for spontaneous evaporation. The remaining somewhat thickish fluid is used for the purpose of either writing or stamping, by the aid of an engraved dye, upon linen or cotton. At first the colour is dirty brown, but it becomes gradually intensely black, an effect instantaneously brought about by moistening the linen or cotton with liquid ammonia.

European Paraffin Oil.—Dr. G. Feichtinger.—It appears that, in Galicia, large quantities of the petroleum (in every respect like the American) occur, and, according to the investigation made by competent engineers, the country alluded to will soon be able to compete with the foreign trade in this article. Well-boring is actively pursued in several localities, but none have as yet reached the main oil-bearing strata, which are known to be at depths varying from 1000 to 1500 feet below the surface.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, December 26, 1872.

This number contains no papers relating to chemistry.

Les Mondes, January 23, 1873.

Contains no papers relating to chemistry.

La Revue Scientifique de la France et de l'Etranger, January 25, 1873.

This number contains no original matter relating to chemistry, but we call attention to the following papers:—

Report on the Conservatoire des Arts et Métiers.—General Morin.—This paper, addressed to the Minister of Agriculture and Commerce, contains a succinct, yet interesting, history of the institution alluded to, originally founded by the celebrated Vaucanson, who, during the reign of Louis XVI., was Inspector-General of Manufactures. The Conservatoire des Arts et Métiers, as now existing, owes its organisation to the first French Republic. The lectures given at this institution are chiefly attended by working men, and the subjects taught are sciences in their application to industry, including mathematical as well as economico-political sciences.

Development of the Human Race.—Dr. Schaaffhausen.—An interesting lecture on this subject.

Bibliography.—Under this heading, we quote the titles of the following works:—"Annuaire du Bureau des Longitudes pour l'An 1873, avec Notices Scientifiques," 1 vol. (Paris: Gauthier-Villars); this small volume contains a large amount of generally useful information. "Cours de Chimie Agricole, Professé à l'Ecole d'Agriculture de Grigaon," par P. P. Dehérain (Paris: Hachette and Co.) This work is highly spoken of, and appears to contain a large amount of useful and practical information.

Bulletin de la Société Impériale des Naturalistes de Moscou, No. 2. 1872.

This number contains the continuation of the following exhaustive monograph:—

The Compounds of Ilmenium and Niobium, and the Composition of the Niobium Minerals.—R. Hermann.—This portion contains the following sections:—Atomic weight of ilmenium, found to be = 654·7; sp. gr. of ilmenium = 5·97; atomic volume of ilmenium = 109·6; oxides of ilmenium, viz., brown, green, and blue; ilmenic acid ($\dot{\dot{I}}\dot{\dot{I}}$); hypo-ilmenic acid ($\dot{\dot{I}}\dot{\dot{I}}$); hypo-ilmenic-ilmenic acid ($\dot{\dot{I}}\dot{\dot{I}}\dot{\dot{I}}$); sulphuret of ilmenium; chloride of ilmenium ($\dot{I}_2Cl_3$); fluoride of ilmenium; combination of ilmenium and potassium fluoride—

$$(2\underline{KFl} + \dot{I}_2\underline{Fl}_3 + \underline{\dot{H}});$$

hypo-ilmenium (*unterilmen*) potassium fluoride ($\underline{KFl} + \dot{I}\underline{Fl}_2 + \underline{\dot{H}}$; ilmenium and potassium; ilmenium and sodium; compounds of the ilmenic acids with soda; ilmenate of soda ($\dot{N}a\dot{\dot{I}}\dot{\dot{I}} + 7\dot{H}$), *ilminiges unterilmen saures Natron*; ilmenious ilmenate of soda ($\dot{N}a_2\dot{\dot{I}}\dot{\dot{I}}_2 + 13\dot{H}$) hypo-ilmenate of soda ($\dot{N}a_2\dot{\dot{I}}_3 + 12\dot{H}$); composition of the niobium minerals; stœchiometrical constitution of the niobium minerals; crystalline shape of the niobium minerals; homoomorphy and heteromery of the niobium minerals and niobium fluorides; enumeration and description (mineralogico-chemical) of the different niobium minerals.

Annales de Chimie et de Physique, January, 1873.

This number contains the following original memoirs relating to chemistry:—

The Spectra of the Metalloids.—Dr. G. Salet.—Illustrated by engravings.

New Studies on Propionic Acid.—I. Pierre and E. Puchot.—The contents of this exhaustive memoir may be summarised as follows:—When propionic acid has been brought to its greatest degree of concentration, it contains the elements of an equivalent of water which cannot be driven off by further distillation. The formula of this acid is $C_6H_6O_4 = C_6H_5O_3,HO$. The boiling-point of this acid is 141·5° at 0·76 barom. The sp. gr. at 0° is = 1·0143. The propionate of baryta, crystallising at from 20° to 25°, contains one equivalent of water of crystallisation, and its formula is $C_6H_5O_3,BaO,HO$. The formula of the crystallised propionate of silver (anhydrous salt) is $C_6H_5O_3AgO$.

Action which Silica and some Analogous Oxides exert upon Carbonate of Soda at a High Temperature.—E. Mallard.—This exhaustive essay treats, in the first place, on the action of high temperatures upon carbonate of soda alone, and further contains the following sections. Action of silica upon carbonate of soda; action of titanic acid; alumina; sesquioxide of iron; boracic acid.

Description of a Constant Level Apparatus for the purpose of Silver Assays by the Wet Way.—G. Sire.—This memoir, illustrated by woodcuts, contains the description of a contrivance for keeping the salt solution used in the process alluded to at a constant level.

Water is not Decomposed by the Electric Current during the Electrolysis of other Substances.—E. Bourgoin.

Detection and Quantitative Estimation of the Combined Carbon Present in Meteoric Iron.—J. Boussingault.—The author's researches have been made with the view to ascertain whether the meteoric iron contains combined carbon in the same condition as obtains in pig-iron and steel. The meteoric iron of Caille (Alpes Maritimes) was found to contain 0·12 per cent of combined car-

Iron; and further to consist in 100 parts of: Iron, 89·53; nickel, 9·76; [illegible] 0·53. The meteoric iron from Lenarto (Hungary) was found to consist in 100 parts:—Iron, 91·50; nickel, 8·58; copper, a trace, carbon and sulphur, none; insoluble, 0·30.

February, 1873.

This number contains no original papers relating to chemistry, but we meet here with several algebraico-physical essays relating to electricity, galvanism, and magnetism.

NOTES AND QUERIES.

Coralline and Blackley Red.—(Reply to P. Burrows).—Coralline is obtained by the action of oxalic and sulphuric acids upon phenol. You will find ample information on this and the other substance you mention in Girard and De Laire's recently published work, quoted in a previous number of the CHEMICAL NEWS, and also in Dr. Elsner's "Chemisch-Technische Mittheilungen" for 1871-72, p. 84. This work can be inspected at the Patent Office Library.

MEETINGS FOR THE WEEK.

MONDAY, Feb. 3rd.—Medical, 8.
—— Royal Institution, 3. (General Monthly Meeting.)
TUESDAY, 4th.—Civil Engineers, 8.
—— Anthropological, 8
—— Zoological, 8½.
—— Royal Institution, 3. Prof. Rutherford, "On Forces and Motions of the Body."
WEDNESDAY, 5th.—Society of Arts, 8.
—— London Institution, 7.
—— Geological, 8.
—— Microscopical, 8. (Anniversary.)
—— Pharmaceutical, 8.
THURSDAY, 6th.—Royal, 8½.
—— Chemical, 8. W. H. Perkin, "On Anthrapurpurine." Dr. C. R. A. Wright, "Isomerism in the Terpene Family of Hydrocarbons." R. S. Dale and C. Schorlemmer, "On Aurine."
—— Royal Institution, 3. Dr. Armstrong, "Formation of Organic Substances."
—— Royal Society Club, 6.
FRIDAY, 7th.—Geologists' Association, 7½. (Anniversary.)
—— Royal Institution, 9. Prof. Ramsay, "Old Continents."
SATURDAY, Feb. 8th.—Royal Institution, 3. Edward A. Freeman, D.C.L., "On Comparative Politics."

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents 54, Chancery Lane, London, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3056. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of maize and other like grain for the production of starch therefrom, and in the utilisation of the waste products for the manufacture of cardboard and paper, and for the preparation of soaps."—A communication from E. Leconte, Paris.—Petition recorded December 30, 1872.

35. W. B. Stephens, Strand, Westminster, "Improvements in the manufacture of paints."—Petition recorded January 3, 1873.

154. H. Y. D. Scott, C.B., Ealing, Middlesex, "Improvements in the treatment of sewage, and of the deposits obtained therefrom."—Petition recorded January 14, 1873.

168. J. L. F. Target, Portsdown Road, Middlesex, "Improvements in treating excreta and sewage matters, and in apparatus employed therein, parts of the apparatus being also applicable to the drying and charring of other matters."—Petition recorded January 15, 1873.

INVENTIONS PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF COMPLTE SPECIFICATIONS.

213. G. Haseltine, Southampton Buildings, London, "Improvements in the manufacture of white-lead, and in the purification of carbonic acid gas used in the said manufacture, and in apparatus therefor."—A communication from A. P. Meylert, New Britain, Conn., U.S.A.

216. L. Stevens, Washington, D.C., U.S.A., "A process for forming carbonic oxide from oxyhydrogen vapour or steam, and an apparatus for utilising the same for heating purposes."—Petitions recorded January 18, 1873.

NOTICES TO PROCEED.

2704. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of sulphate of soda."—Petition recorded September 12, 1872.

2801. J. McDougall, Manchester, "Improvements in the manufacture of manures."—Petition recorded September 21, 1872.

3067. W. Morgan-Brown, Southampton Buildings, London, "An improved composition for preserving wood, metal, stone, brick, paper, textile and felted fabrics, cordage, and cables."—A communication from F. O. Möller, Rue Lavoisier, Paris.—Petition recorded October 17, 1872.

3930. B. White and P. T. Hendry, Glasgow, N.B., "Improvements in treating liquids to be burned for illuminating purposes."—A communication from J. Hall, jun., Cincinnati, U.S.A.—Petition recorded December 27, 1872.

3957. J. W. Spencer, Newcastle-on-Tyne, "Improvements in the production of iron."—Petition recorded December 30, 1872.

3968. G. T. Bousfield, Sutton, Surrey, "Improvements in the manufacture of steel, and in apparatus employed for this purpose."—A communication from T. R. Scowden, Cincinnati, U.S.A.—Petition recorded December 31, 1872.

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THE CHEMICAL NEWS.

Vol. XXVII. No. 689.

THE ADULTERATION ACT.

It was naturally supposed when the new Adulteration Act was passed that the fraudulent admixture of substances with articles of food and medicine would be abolished, by reason of the offence being made criminal, and by the fact that duly qualified men were expressly to be appointed as analysts, to whom articles of food, &c., were to be submitted for examination. This has now proved a delusion; in the first place it is necessary to the working of the new law that duly qualified chemists be appointed. Such a man would be one who had studied chemistry at some University or recognised School of Science, and had been engaged in all kinds of analytical work or scientific research daily for at least four years previous to his appointment. If an adulterated substance be put for analysis into the hands of a man wanting in the amount and nature of the experience thus indicated, a trustworthy report cannot be expected, and either the offender may escape conviction or the innocent may be unjustly accused of a criminal offence. What is actually the state of things just now? Out of many appointments already made, not more than two or three are filled by persons having the necessary knowledge their duties require. It is a positive fact that some of these men are endeavouring to get a few private lessons in chemistry, vainly imagining that they may, by the help of a book and a few hints scraped together, be able to make some pretence of work. The vestries for the sake of economy offer a paltry £100 or £150 a year to the salary of their medical officers to undertake the analyses. Now what is, generally speaking, the scientific experience of these gentlemen? At a remote period of their student days they were required to be present at not more than sixty chemical lectures, and sixty hours of the most elementary laboratory practice: in such work boys in the Grammar Schools of Birmingham and Manchester could excel them. Even the little knowledge then gained has by this time faded away, and they could not, off-hand, establish the difference between sulphate of zinc and Epsom salts, much less the presence of alum in bread or bromide in iodide of potassium. Adulterators may continue their evil practices relying in cases where detection may ensue that the criticism of an able chemist will so damage the evidence as to render conviction impossible. A humbling picture of a Local Government Board engaged in electing an analyst was lately afforded by a report of the proceedings in a recent copy of the *Times*. The request of the medical man that he should be authorised to spend not more than £100 in fitting up a laboratory with the necessary apparatus for his chemical work was "received with much laughter." A vestryman stated that he possessed a laboratory in which he could do almost anything which cost only 20s. The analysts should be appointed by Government: it is hardly to be expected that vestrymen will encourage competent persons to produce evidence damaging possibly to some of their own body. It is disgraceful that a parliamentary measure of such good intentions should be made a farce, and we recommend that a statement of how the matter at present stands be forwarded by the Chemical Society to Mr. Stansfeld.

DEHYDRATION (WASSERENTZIEHUNG) IN THE LIVING ANIMAL ORGANISM.

By M. NENCKI.

In consequence of the discovery made by Voit that there exists in the living animal organism an equilibrium of nitrogen (*Stickstoffgleichgewicht*), so that nearly all the nitrogen taken up as food is eliminated from the body in the shape of urea, it has become the custom to view the animal body as almost exclusively an oxidising agent, and upon this view have been based calculations—such as those on the combustion-heat generated in the animal body—which, as this view does not apply to the vegetable reducing bodies (*reducirenden planzenkörper*), cannot be correct.

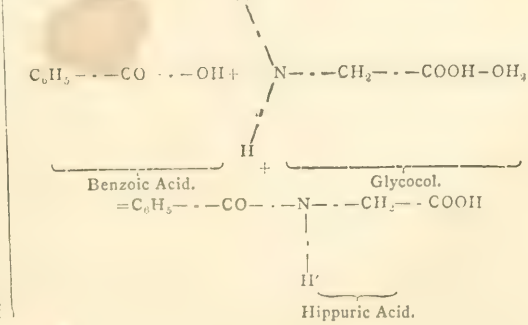
Liebig has recently observed (*Ann. d. Chem. u. Pharm.*, vol. cliii., p. 173) that the researches made by Dr. Frankland on the heat of combustion yielded by the substances used as food are correct for ascertaining the heat which these substances will yield when used as fuel in the furnace of a steam-boiler, but are of little, if any, value in respect to the valuation of the heat yielded by them in the living body.

Later researches have, moreover, proved that, simultaneously with oxidising processes, there are going on in the living animal organism other processes, which we are accustomed to view as the opposite of oxidation, and these should be taken into account in making calculations. The formation of benzoic from quinic acid in the living animal organism is due to a reduction, as is also the conversion of bilirubin into pigment of urine, as lately discovered by Maly.

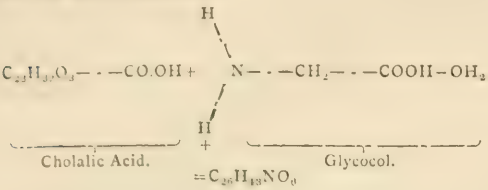
Baeyer (*Ber. d. Deutsch. Chem. Gesells.*, 1870, p. 63) has published his researches on the possible cases of dehydration of combinations consisting of C, H, and O, and has thence deducted the two reactions which take place after dehydration or withdrawal of water, viz., (1) formation of anhydride, and (2) condensation. The importance of this process in the life of plants, as pointed out by Baeyer, has been confirmed by his recent researches on a new class of dyes which, in many respects, closely agree with those occurring naturally.

It is my intention to give a review of the facts relating to dehydration as recent researches have shown to be going on in the animal body, and there can be no doubt that a correct knowledge of these facts is of high importance.

While the N and the C of the albuminates used as food are probably only held together by one affinity—which is certainly the case with their immediate products of splitting up, viz., the preliminaries or preceders (*vorstufen*) of urea (leucin, glycocol) which occur only in that form—we frequently find combinations in the animal body the origin and presence of which is due to elimination of water (*wasseraustritt*), and in these compounds the N is chiefly fixed as C— - —N— - —C, but also as C≡≡≡N, to C. This double or triple fixation of N to C, which occurs after the elimination of water (formation of amide or nitrile), may be viewed as condensation, and is then analogous to the compounds resulting from elimination of water from the C, H, and O combinations. Thus the formation of hippuric acid and other aromatic glycocol compounds in the organism is due to withdrawal or elimination of water, and after that has taken place the N is fixed with two affinities to the C, analogous to the outer (*äusseren*) condensation of the C, H, and O compounds—

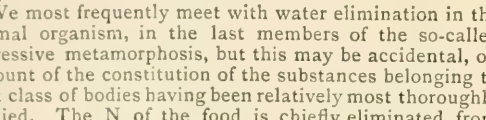


The formation within the organism of the duplicate gall acids, the glyco- and tauro-cholic acids, is based upon the same reaction—

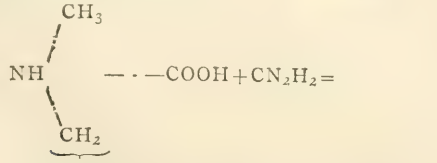


The withdrawal of water in non-nitrogenous substances is at present only known in one instance, with formation of anhydride, viz., in the conversion of grape sugar into glycogen. According to researches made by Dr. Schöpfer* in the laboratory at Bern, which fully confirm the exhaustive ones of Dr. Bernard on this subject, solutions containing 15 per cent of grape sugar, and, injected into the branches of the vena portarum, are retained by the liver, while, if the same solution is injected in any other vein of the body, two-thirds of the sugar injected is emitted with the urine. Dr. Schöpfer calculated from his experiments that the liver of a medium-sized rabbit can in one minute convert about 0·12 grm. of sugar. It is scarcely possible to assume that the sugar should not be retained in the shape of glycogen, since I have found that when substances containing sugar have been given as food, the blood of the vena portarum always contains sugar, while glycogen is simultaneously largely generated in the liver. The formation of the cholesterine of wax, and that of the fats from carbohydrates in the animal organism, can only be explained by the elimination of O in the shape of OH_2, aided by a partial oxidation of the original substance.

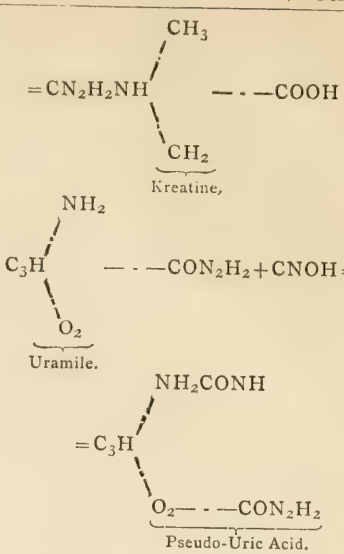
We most frequently meet with water elimination in the animal organism, in the last members of the so-called regressive metamorphosis, but this may be accidental, on account of the constitution of the substances belonging to that class of bodies having been relatively most thoroughly studied. The N of the food is chiefly eliminated from the body in the shape of urea, and next as kreatine, uric acid, xanthine, guanine, and other substances belonging to the uric acid group. The origin of these substances is due to elimination of water, as may be elucidated by the general formation formula—mCO + nCO$_2$ + NH$_3$ – pH$_2$O. Dr. Schultzen's recent researches have clearly explained the formation of urea in the animal body—



It is evident that the attempts to convert albuminous substances by direct oxidation into urea are in a physiological sense quite useless, since the formation of urea in the animal body is based upon totally different processes. As proved by the synthesis of kreatine by Dr. Volhard, the elimination of water has in this instance proceeded as far as the formation of cyanamide (nitrile of carbaminic acid). In this case the cyanamide is simply added to the sarkosine, as the cyanogen is to the barbituric acid, and the cyanuric acid to the amido-groups of the uramile in the formation of pseudo-uric acid—



* "Beiträge zur Keuntniss der Glykogenbildung in der Leber," von Dr. E. Schöpfer. Inaugural Dissertation; Bern, 1872.



We may take it for granted that the formation of kreatine in the organism takes place, as it does when artificially produced, by the combination of cyanamide with sarkosine. According to Schultzen's investigations, the sarkosine used as food combines, with elimination of OH_2, with the elements of carbaminic acid. The reason why the sarkosine is not all eliminated from the animal organism as kreatine is doubtless in a great measure due to the large accumulation of the former in the organism; the daily quantity of kreatinine emitted with urine, and derived from kreatine, amounts in human beings to from 0·6 to 1·3 grms. It is, however, probable that under normal conditions a small quantity of urea eliminates in certain parts of the organism another molecule of H_2O, and that the cyanamide thus formed combines with sarkosine to form kreatine.

The Schultzen's substance is not the only one which, after the use of sarkosine as food, is met with as sarkosine instead of urea in the urine, and it will be highly interesting to ascertain how the secretion of kreatine, and also of kreatinine, stands when sarkosine is used as food. The formation of uric acid, xanthine, and sarkine in the human body is doubtless based upon similar processes. In uric acid, at least, the most probable constitutional formulæ would indicate the presence of the cyanamide group, and it is just by proving the dehydration in the process of the formation of these bodies in the organism that the main interest of the artificial preparation of uric acid is based. The investigations and experiments of many scientific chemists engaged in this direction will in all probability add largely to our knowledge of this subject. —*Ber. d. Deutsch. Chem. Gesells.*

ON THE

COMPOSITION AND ORIGIN OF THE WATERS OF A SALT SPRING IN HUEL SEATON MINE,

WITH A

CHEMICAL AND MICROSCOPICAL EXAMINATION OF CERTAIN ROCKS IN ITS VICINITY.*

By J. ARTHUR PHILLIPS, Mem. Inst. C.E.

HUEL Seton Copper Mine is situated about one mile north-east of the town of Camborne, Cornwall, and is distant from the sea, on the north coast, a little more than 3 miles.

* Abstract of a Paper read before the Royal Society, January 30.

The workings of Huel Seton are entirely in "killas," or clay-state, and the saline waters issue at the rate of 50 gallons per minute, and at a temperature of 92° F., from the eastern fore-breast of the 160-fathom level. This has intersected a fault, or cross-course, which may be traced in a northerly direction to the sea. The temperature of the level from the end of which the water issues, like that of the water itself, is 92° F. The following results, in grammes per litre and grains per gallon, were obtained by analysis. Sp. gr., 1·0123. Total solid contents, 14·3658 grms. per litre, or 1005·61 grains per gallon.

	Grammes per litre.		Grains per gallon.	
	I.	II.	I.	II.
Carbonic acid	0·0795	0·0786	5·56	5·50
Sulphuric acid	0·0178	0·0177	1·25	1·24
Silica	0·0270	0·0280	1·89	1·96
Chlorine	9·1728	9·1662	642·10	641·63
Bromine	trace	trace	trace	trace
Alumina	0·3456	0·3460	24·19	24·22
Ferric oxide	0·0031	0·0033	0·22	0·23
Manganese	trace	trace	trace	trace
Copper	minute trace	minute trace	minute trace	minute trace
Lime	3·4795	3·4963	243·56	244·74
Magnesia	0·0721	0·0710	5·05	4·97
Alkaline chlorides	6·4920	6·4626	454·44	452·38
Potassium	0·0832	0·0835	5·82	5·84
Cæsium*	trace	trace	trace	trace
Sodium	2·2977	2·2885	160·84	160·19
Lithium	0·0805	0·0794	5·63	5·56
Ammonia	trace	trace	trace	trace
Nitric acid	trace	trace	trace	trace

The foregoing results may be thus tabulated †:—

	Grammes per litre.		Grains per gallon.	
	I.	II.	I.	II.
Calcium carbonate	0·0921	0·1011	6·45	7·08
Ferrous carbonate	0·0045	0·0047	0·31	0·33
Manganous carbonate	trace	trace	trace	trace
Calcium sulphate	0·0303	0·0301	2·12	2·11
Cupric chloride	minute trace	minute trace	minute trace	minute trace
Calcium chloride	6·7697	6·7934	473·88	475·54
Magnesium chloride	0·1712	0·1686	11·98	11·80
Aluminium chloride	0·9003	0·9013	63·02	63·09
Potassium chloride	0·0919	0·0900	6·43	6·30
Calcium chloride	trace	trace	trace	trace
Sodium chloride	5·8442	5·8210	409·09	407·47
Lithium chloride	0·4888	0·4820	34·22	33·74
Potassium bromide	trace	trace	trace	trace
Potassium silicate (K_2SiO_3)	0·0693	0·0719	4·85	5·03
Nitric acid	trace	trace	trace	trace
Ammonia	trace	trace	trace	trace
Total found by addition of constituents	14·4623	14·4641	1012·35	1012·49
Total found directly‡	14·3658	—	1005·61	—
Free carbonic acid	0·0373	0·0323	2·61	2·26

A consideration of the various phenomena connected with the occurrence of this and other apparently similar springs, which have at different times been discovered in the district, would seem to lead to the inference that they all have some more or less direct communication with the sea, and that they are either the result of infiltration of sea-water through faults, or are true and independent sources which, before being tapped below the sea-level, had found their way to the ocean through faults or channels.

The following would appear, in the present state of our knowledge, a not improbable explanation of the origin of the Huel Seton spring.

The cross-course is believed to extend through both granite and clay-slate to the sea. From the close contact of its surfaces, the presence of clay, and from other causes, this fault may be supposed not to be uniformly permeable by water, which can only follow a circuitous passage. In this way it penetrates to depths where reactions take place, which, although not entirely in accordance with the results of daily experience in our laboratories, can, after the investigations of M. Daubrée, M. de Sénarmont, and others, be readily understood.

By the action of sea-water on silicates of calcium, silicates of sodium and chloride of calcium may be produced. The sulphate of sodium of the sea-water will be decomposed by this chloride of calcium, with the production of sulphate of calcium and chloride of sodium. The decomposition of clayey matter by common salt may produce chloride of aluminium and silicates of sodium, while the magnesium of the chloride of magnesium may be replaced by calcium; lastly, a portion of the potassium in the sea-water appears to have been replaced by the lithium of the granite.

* The amount of cæsium appears to be very small. On adding chloride of platinum to a rather dilute solution of the alkaline chlorides obtained from this water, a slight yellow precipitate was deposited; this, after re-solution and the removal of the platinum by sulphuretted hydrogen, afforded by the spectroscope somewhat faint indications of the presence of cæsium.

† As the state of combination in which the various substances present in mineral waters exist cannot be accurately determined, the system of grouping adopted in the table must to some extent be regarded as arbitrary.

‡ The difference between the amount of total solid contents found directly and that obtained by addition of constituents, is doubtless in a great measure due to the partial decomposition of aluminium and magnesium chlorides at the temperature (180° C.) at which the drying of the residue was effected.

RESEARCHES ON THE NATURAL PRODUCTION OF NITRATES AND NITRITES. APPLICATION OF MINERAL MANURE TO HORTICULTURE.

By J. JEANNEL.

MANY phytophysiologists and horticulturists believe that it is impossible to grow plants in a sterile soil by means of artificial food composed of mineral substances dissolved in water. My aim is to prove by experiments, the results of which I shall presently describe, that:—(1). Nitrates or nitrites are naturally formed in soil containing organic vegetable matter when in contact with air. (2). That it is possible to feed plants with solutions of mineral compounds suitably prepared, so that the plants receive from these solutions the mineral constituents they require, and may thus grow more vigorously even in pure sand than in the best garden-mould.

This opinion was put forth in 1856 by Boussingault while experimenting on the growth of the *Helianthus*. The eminent *savant* then said that the plant assimilates the mineral substances, and need not necessarily be placed in a soil containing decaying organic matter. And this opinion is also confirmed by the experiments of G. Ville, which prove the importance of chemical manures in agriculture. I have utilised the opinions of Boussingault, Millon, and Schœnbein on the natural production of the oxygen compounds of nitrogen; and at the same time have somewhat modified them. I first studied the natural conditions of the formation of nitrates in arable soil, without the intervention of ammonia, simply from the elements of air and the reduction of these nitrates by humus. I applied Schœnbein's reagent (solution of iodised starch acidulated with sulphuric acid), which strikes a blue colour in the presence of nitrites. By the aid of this reagent I ascertained the following facts.

When arable soil or garden-mould is well washed in a displacing apparatus with pure distilled water, that fluid always exhibits the presence of nitrites. It is, however, necessary to use—for the complete removal of the nitrites

from the soil—about twelve times the quantity by weight of distilled water to the weight of the soil experimented upon. The soil thus treated having been again dried, yields, after a short time, nitrites, as indicated by Schœnbein's test in the water employed a second time for exhausting the soil. Sandy soils, and all those which do not effervesce when treated with acids, do not recover nitrites after being dried unless carbonate of lime is added, and the soil then moistened with water and again dried, and lastly washed with distilled water, which then exhibits the reaction for nitrites.

When a solution of the nitrates of potassa and ammonia at $\frac{5}{1000}$ is made to pass through the arable soil or garden-mould previously well washed with water, the soils being placed in a displacement apparatus,it will be found (as I also ascertained) that the nitrates are retained in the soil. 1 kilo. of the soils—which require to be moistened with about half their weight of water—retains about four-fifths of the soluble salts contained in the first litre of the saline solution at $\frac{5}{1000}$, which is poured on to the soils. Nitrate of ammonia is retained by the soil in larger proportion than nitrate of potassa. The alkaline nitrates are in 24 hours reduced to nitrates when in contact with dead leaves, straw, or humus. That reduction is so marked that when dead leaves are washed with distilled water, the leaves distinctly exhibit, with Schœnbein's reagent, the presence of nitrites, due to the nitrates naturally present in the well-water of Paris. These facts appear to me to lead to the following conclusions:—

(1). Soils containing humus and lime determine, while drying, the combination of the elements of the air, without any intervention of ammonia, so that either nitric or nitrous acids are formed, which are at once fixed by the lime. This explains, not only the sterility of soils void of lime and of peat-bogs, but also the utility of liming the soils.

(2). The nitrate of ammonia contained in rain-water and in dew (Millon and Schœnbein) is retained by the humus in the upper layer of the soil, with the nitrites constantly formed in the well-aërated and limed soil, according to the conditions of the atmospheric moisture or dryness.

(3). This constant formation and renovation of the oxygen compounds of nitrogen in soil containing lime and humus is a fact of great importance, which explains the exceptional fertility of the soil in alternate wet and dry weather, when frequent showers of rain are followed by great heat, as was the case in 1872 (in France, at least). It also, in connection with the great affinity of the humus for soluble salts, more especially ammoniacal, accounts for the accumulation of fertilising principles in fallow lands, and at the same time shows the utility of mechanical operations in the soil, such as ploughing, digging, harrowing, &c., by which means contact with the air is increased and free access of air promoted. I have tried to elucidate these theories by a series of different horticultural experiments, specimens of which I send to the Academy.

I. *Comparison between Plants Grown in Sand and in Garden Mould.*—The plants placed in sand have been supplied every week, in addition to receiving ordinary water, with a solution of some decigrammes of mineral manure dissolved in water. The plants placed in garden-mould have only had common water. The pots were placed on saucers, in order to prevent loss of soluble salts. I exhibit, as specimens of this experiment, two plants of the *Pelargonium zonale* and two of the *Agave corniculata*, which in April last were all in the same stage of development. The *Pelargonium* grown in the sand is four times as much developed as that grown in the garden-mould, and has been constantly in bloom during the summer; the *Agave* grown in the sand is twice as large as that grown in the garden-mould.

II. *Plants Grown only in Sand;* but some watered with common water only, others with the mineral solution, once a week.—I exhibit here, as specimens, several *Arum italicum*, and state that I have, during the summer, made a large number of similar experiments with plants belonging to different natural families, such as *Begonias*, *Trandentias*, *Veronicas*, &c. The plants grown without the addition of mineral manure are either dead or drooping, while those raised with the addition of that manure have grown magnificently.

III. *Plants Grown only in Garden-Mould*, to some of which only common water has been given, and to others, in addition to that fluid, a quantity of the mineral manure solution has been supplied weekly.—As a specimen of the result of this experiment, I exhibit two specimens of *Sedum acre*, the plant which has received weekly 2 decigrms. of the mineral manure solution having grown twice as much as the other.

IV. *Plants which have remained for Two Consecutive Years in the same Soil in Pots.*—These, as far as they have been treated with my mineral manure, have grown so well that their size is altogether out of proportion with the pots which contain them. As samples, I exhibit an *Aspidistria elatior* and an *Arum esculentum*.

The mineral manure which I use is made up according to the results of elementary analysis of wheat and of farm-yard manure, taking into consideration that the arable soil, containing organic matter, acts constantly as a nitre-bed, and thus fixes the elements of the air into combination. The manure consists of the following ingredients:—

Nitrate of ammonia	400 parts.
Nitrate of potassa	250 ,,
Biphosphate of ammonia ..	200 ,,
Chloride of ammonium ..	50 ,,
Sulphate of lime (gypsum)	60 ,,
Sulphate of iron	40 ,,
	1000

The salts should be pulverised separately, and then intimately mixed. I apply this manure in the following manner:—Dissolve 4 grms. in a litre of water; give to the plants, according to their state of development, every week from 25 to 150 grms. of this solution (equal to from 1 to 6 decigrms. of the salt in solid state).

Conclusions.—(1). Plants can be fed by means of artificially-made mineral solutions. (2). Horticulture may greatly profit by this mode of growing plants, because it renders re-potting unnecessary, and because the nature of the soil becomes a matter of entire indifference, provided it offers to the plants a proper and sufficiently permeable hold; while, lastly, the plants can be fed at will and when most convenient.—*Comptes Rendus.*

ON THE COMPOSITION OF THE LYES WHICH ARE OBTAINED BY THE OXIDATION AND LIXIVIATION OF SODA WASTE FOR THE RECOVERY OF SULPHUR.*

By C. STAHLSCHMIDT.

The soda waste is worked for sulphur on a large scale according to two chief methods, which do not materially differ as to the principle. The first was introduced by Guckelberger and Mond, the second by Schaffner. Both methods are frequently combined, adapted to the circumstances; after thoroughly testing both, the best features of each have been chosen and retained.

Before entering into the examination of the sulphur lye, I will give a cursory description of the manner in which the lyes which I examined were obtained, and of the preparation of sulphur therefrom. The method to be described is employed in the Rhenania chemical works at Stollberg (near Aix-la-Chapelle), from where I obtained the lyes.

* Translated by M. Alsberg, Ph.D. From *Dingler's Polytech. Journal*, vol. 205, No. 3.

The soda waste is brought directly away from the lixiviating vats into the oxidising tanks, four of which are connected to one system and are otherwise arranged like soda lixiviating tanks. The size of the tanks varies in the different systems, some are 4 feet by 8 feet, others 8 by 8, and 8 by 16. The tanks have a double perforated bottom and the space between the two is connected by a pipe and register, for regulating the quantity of air, with the air main. The soda waste having been filled into the tanks is oxidised, during 12 to 16 hours, by forcing air through it, which is furnished by a ventilator, and has a pressure of 4 millim. water, and lixiviated with weak lye from a preceding operation; this oxidation and lixiviation is repeated five or six times. Finally the tank is filled with pure water, emptied and filled with fresh waste. By this systematic lixiviation the liquor is brought to 10°—12° B.; it is run off into clarifying vats, from which it passes into the apparatus for decomposition. The latter is a large, round, wooden tank, lined with lead, closed with an air-tight cover, having a large pipe for carrying off the gases and a stuffing box for the shaft of the stirrer; the pipe is connected with a chimney. On one side of the tank, about one foot from the cover, are the pipes for lye and muriatic acid; on the other side, at a distance above the bottom equal to one-third of the height of the tank, a two-inch pipe for drawing off the sulphur suspended in the decomposed lye. By means of a steam pipe the contents can be heated to 60° C. by direct steam. At different heights of the tank there are small cocks, by which samples are drawn off in order to ascertain the necessary amount of acid. Lye and acid of 20° B., in the proportion of 8 : 1 to 7 : 1, are alternately run into the tank in small quantities, first the lye, then the acid. Each batch of acid and lye amounts to a height of about 3 centims. in the tank. The alternate filling with lye and acid is continued until the apparatus is full, the stirrer being in motion meanwhile; then the mixture is heated to 60° C., stirred for a short time, and finally enough acid is added, that a sample distinctly shows the smell of sulphurous acid. For this purpose a small quantity of acid is generally sufficient.

The skilful workman can easily detect the point of complete precipitation by the colour and odour of a sample. The conditions having been fulfilled, the decomposed lye is drawn into the settling vats, one-third remaining in the tanks; the sulphurous acid contained in this part is intended to prevent the disengagement of sulphuretted hydrogen, when fresh lye is added. In the settling vats, the sulphur settles almost completely, and rapidly; while the lye of calcium chloride, after the filling of the first vat, runs into a second at a lower level, and from this into a third at the same level, in which two the sulphur settles completely. The solution of calcium chloride is run off, having no value. The sulphur is lifted from the settling vat into a funnel-shaped wagon, from which it falls directly into the well-known refining apparatus of Shaffner.

As regards the composition of the lyes respecting the compounds which they contain, the views of the chemists who have examined them differ materially. Especially is the case with regard to the higher sulphide of calcium, which is supposed to exist in the lyes, as well as to the reactions by which the compounds are formed in the waste during the oxidation or lixiviation. According to W. Hofmann, the calcium-monosulphuret supposed to exist in the waste is decomposed into calcium oxide and calcium disulphuret, the former being converted into calcium carbonate by the carbonic acid of the atmosphere, the latter into calcium hyposulphite by oxidation. By the elevation of temperature during the oxidation, the latter is immediately split into sulphur and calcium sulphite, which by further oxidation is transformed into calcium sulphate. The free sulphur converts another part of calcium disulphuret into higher polysulphurets, *i.e.* into CaS_3 and CaS_4.

C. Mène, who gave a description of Mond's method, supposes the oxidation to take place in such a manner that to 1 mol. calcium hyposulphite and 2 mols. calcium monosulphuret are formed; a hypothesis which is defended by Mond himself. According to Mond, at first calcium sulphhydrate and calcium disulphuret are formed, both of which are afterwards oxidised to calcium hyposulphite. Part of this is again decomposed to calcium sulphhydrate and calcium sulphite, which latter as an insoluble substance causes loss of sulphur. According to Mond, the resulting lye always contains calcium hyposulphite, calcium sulphhydrate and calcium polysulphuret of the formula CaS_2.

Mond was the first to put forth the interesting opinion, based on experiments, that by the decomposition of the lyes with muriatic acid, the calcium hyposulphite is not split into calcium sulphite and sulphur, $CaS_2O_3 = CaSO_3 + S$, but into calcium trithionate mixed with small quantities of calcium pentathionates.

$$5CaS_2O_3 + 6HCl = 3CaCl_2 + 3H_2O + 2CaS_3O_6 + 4S.$$

On being heated, the calcium trithionate is decomposed into calcium sulphate, sulphur, and sulphurous acid, the latter converting another part of calcium hyposulphite into calcium trithionate with the separation of sulphur, $2CaS_2O_3 + 3SO_2 = 2(CaS_3O_6) + S$. In the same manner the decomposition and formation of calcium trithionate go on, thus accounting for the presence of calcium sulphate in the precipitated sulphur. Schaffner opposes this assumption, and explains the formation of the calcium sulphate by the presence of sulphuric acid in the crude hydrochloric acid used for the decomposition. According to him, by the oxidation of the waste calcium hyposulphite and the polysulphurets CaS_2 and CaS_5 are formed.

Considering that the soda process is conducted in the same manner in all existing works, it is safe to presume, that with regard to the qualitative composition there are no differences, and that, further, likewise the oxidised waste and the resulting lyes must be analogous. The quantitative composition of the sulphur lyes, however, as has been proved by Richtors, can show great differences, *i.e.* the different compounds formed by the oxidising process can be present in the sulphur lyes in varying proportions. The cause of the difference in the composition of the lyes is the duration of the oxidation, the temperature, and perhaps the varying amount of moisture in the waste. It is generally conceded, that in the sulphur lye the compounds of sodium and calcium with hyposulphurous acid are present, and likewise the sulphhydrates of these two metals. The statements regarding the compounds of the two named metals with sulphurous acid are inaccurate; it is only mentioned, that the calcium sulphite is insoluble and causes loss of sulphur. The statements about the polysulphurets of the metals are entirely contradictory, it being assumed, in order to explain the process, that the lye contains, besides calcium sulphhydrate, calcium di-, tri-, tetra-, or penta-sulphuret. As far as I know, a sodium polysulphuret has never been mentioned, although it is highly probable, that, according to the preparation of the lye, such a one is formed.

With regard to the compound of calcium and sulphur, the excellent researches of Emil Schöne have not been taken into consideration, which show beyond doubt, that the old views about the calcium sulphurets are erroneous.

The experiments of Vauquelin, which were made as far back as 1817, prove that no calcium polysulphurets can be obtained by the dry process. Buchner, 1816, and Herschel, 1820, obtained in the wet way compounds of calcium and sulphur, which were considered as being composed of calcium oxide, sulphuretted hydrogen, and water. Later, in the year 1842, Heinrich Rose obtained, by a method differing from that of Buchner and Herschel, crystals, resembling in their appearance those prepared by the latter, and to which Rose assigned the formula $CaS_5.5CaO + 20H_2O$. The compound, therefore, contained the CaS_5 of Berzelius, which is formed by saturating CaS with sulphur in solution.

Schöne, who subjected this matter to an extensive examination, found that solutions of calcium polysulphurets on evaporation never separate pure polysulphurets in a cystalline form, or leave them afterwards in a solid and pure state; they are decomposed by water with the diseng agement of sulphuretted hydrogen and the separation of a solid mass, consisting of calcium hydrate and sulphur. In order to ascertain which calcium polysulphurets can exist in solution, calcium monosulphuret, prepared from pure carbonate of lime, bisulphide of carbon, and carbonic acid at an elevated temperature, was boiled with different quantities of sulphur and water. The experiment proved, that calcium, with less than four molecules sulphur cannot exist in solution, and that if less than three molecules sulphur to one molecule CaS were brought in contact with water, only enough calcium sulphuret went into solution to form CaS_4, that the remainder of the CaS was indifferent toward the sulphur and was decomposed by the water in the manner indicated by Rose into calcium hydrate and calcium sulphhydrate, the former of which dissolving partly, the latter entirely, with the tetrasulphuret, Schöne has given the following formulæ for this highly interesting reaction:

1. $6S+6CaS+4H_2O=2CaS_4+2CaH_2S_2+2CaH_2O_2$.
2. $12S+6CaS+2H_2O=4CaS_4+CaH_2S_2+CaH_2O_2$.
3. $18S+6CaS=6CaS_4$.

In the experiments 1 and 2, the presence of the calcium sulphhydrate was proved by solution of manganese sulphate; in the solution 3 only traces of this compound were found. The CaS_4 formed in these experiments can dissolve another molecule S, if hot even more, and therefore corresponds completely with the sulphurets of barium and strontium. Like these latter compounds CaS_4 has the property, but in a higher degree, of crystallising together with lime and forming those compounds, which have been examined first by Herschel and Buchner, and later by H. Rose. Schöne obtained Herschel's compound by boiling pure caustic lime with sulphur and much water for an hour, filtering the hot solution and letting it stand with pure calcium hydrate. The crystals formed upon the latter after some days, had, after drying over sulphuric acid, the composition $3CaO,CaS_4+12H_2O$. According to Schöne, for the formation of this compound, the presence of lime and calcium hyposulphite is necessary; without the latter salt it does not form.

The crystals obtained by Rose, of the above formula, were formed from a solution of calcium sulphhydrate, if it was evaporated with free excess of air. Schöne obtained the crystals by treating a large quantity of milk of lime with sulphuretted hydrogen for several days and leaving the filtered lye closed not quite tight for 6 months. The lye, which had turned yellow, was then evaporated to half its bulk, when a large quantity of sulphuretted hydrogen was evolved, and calcium hydrate separated. After being left in a cool place for several weeks, numerous orange-yellow prismatic crystals had appeared, which had the composition $4CaO,CaS_4+18H_2O$. The compound, therefore, does not contain CaS_5, as Rose thought, but CaS_4 combined with CaO and H_2O; according to Schöne it is probably always formed when CaS_4 meets CaH_2O_2 and CaH_2S_2.

These facts evidently show, that in the lyes from soda waste, no other polysulphuret but CaS_4 and CaS_5 can exist, as Schöne has proved by experiment that lower polysulphurets cannot exist in solution. The great affinity of CaS_4 for CaO and water, with which it forms crystallised compounds, must also in the sulphur lyes make itself felt, producing in the first place the compound $4CaO,CaS_4+18H_2O$, because it is mainly formed under the precautions observed in the preparation of the lyes, *i.e.* at an ordinary, or slightly elevated temperature. As I shall show later, the hyposulphurous acid as well as part of the sulphhydrate are present in the lye as sodium compounds, and therefore it is not impossible, that sometimes the compound $3CaO,CaS_4+12H_2O$ may be formed, provided it is correct, that for the formation of the two compounds the presence of calcium sulphhydrate respecting calcium hyposulphite is required. In this case, however, I should like to extend this view so far, that the formation of the two salts entirely depends on the presence of a sulphhydrate or a hyposulphite.

According to Schafiner, the amount of sodium in the waste corresponds to 4—5 per cent sodium sulphate; it is asserted, that by the oxidation it is almost completely dissolved, whence it follows, that in the examination of the lyes, the sodium compounds must be taken into account. I now come to the examination of the lye mentioned above; to which I was led by the formation of splendid orange-coloured, spear-like crystals, 3—5 inches long, which had formed in the lye after it had been standing for several months with the exclusion of air, and which analysis proved to be $4CaO,CaS_4+18H_2O$.

Separated from the lye, the crystals decomposed while still moist, turning lighter, and finally quite white. In contact with water after some time, or by being warmed with it, they were completely decomposed, calcium hydrate and sulphur being formed with the evolution of sulphuretted hydrogen.

A determination of the sulphur and calcium in the moist salt, in order to ascertain the relative quantities of the two elements, gave 15·7 per cent sulphur to 23·64 calcium, the formula $4CaO,CaS_4+18H_2O$, requires the proportion 15·13 sulphur to 23·64 calcium. The salt pressed between filtering paper, dried at 100° C., gave 35·21 per cent loss. According to Schöne, it loses, under these conditions, three-fourths of the total amount of water, and about one-half of the sulphuretted hydrogen, which it evolves with acids. The loss, therefore, would be 36·2 per cent, a figure which in this case corresponds sufficiently with the one found.

0·4955 grm. of the salt were oxidised with aqua regia, the non-oxidised sulphur was filtered, in the filtrate, the lime was first precipitated by ammonia and oxalate of ammonia, and then the sulphuric acid by barium chloride. 0·347 grm. $CaCO_3$ and 0·0842 grm. sulphur were obtained.

0·311 grm. were gently heated with oxide of copper and binoxide of lead in a current of air, as in an organic combustion, and yielded 0·138 grm. water.

	Found.	Average. According to Schœne.	Calculated.
Ca	28·01	28·47	27·93
S	17·00	16·99	17·88
H_2O	44·34	45·27	45·25

The crystals are much more stable in the dried than in the moist state, but even over sulphuric acid they continually give off sulphuretted hydrogen, and soon lose their lustre, assuming a darker colour. Crystals of this kind contained 29·49 per cent calcium and 19·68 per cent sulphur.

If the clear sulphur lye is mixed with absolute alcohol, almost instantly shining scales and needles of yellow colour are formed, which by standing for some hours grow to thin plates. They behave towards reagents like the large oxytetrasulphuret crystals, and have the same composition.

0·6367 grm. gave 0·109S and 0·176 Ca.
0·226 ,, ,, 0·100H_2O.

This corresponds to 17·10 per cent S, 27·6 per cent Ca, and 44·2 per cent H_2O.

For the determination of the sulphur in the crystals, Schöne made use of the chlorine analysis, decomposing the crystals in water by a current of chlorine and determining sulphur and calcium in the solution in the above manner. Thus he intended to avoid a loss of sulphur, caused by the evolution of sulphuretted hydrogen. My analyses show the determination of sulphur by means of aqua regia to be at least as accurate. Another method, which excludes all loss of sulphur, gives accurate results, and is well adapted for all similar sulphur compounds, is the following: The compound is mixed with very little water, powdered chloride of copper, and then with a little dilute hydrochloric or nitric acid, whereby the sulphur-

etted hydrogen, which would be set free, and a part of the remaining sulphur, are instantly converted into sulphide of copper. By adding strong nitric acid, and boiling, a clear copper solution is obtained, in which the sulphuric acid is determined. The non-oxidised sulphur is previously filtered and weighed. An analysis of the calcium oxytetrasulphuret, made in the manner described, gave 17·35 per cent sulphur.

If the calcium oxytetrasulphuret is decomposed by hydrochloric acid, sulphur separates and hydrogen trisulphide is formed, which has been detected in the decomposed lyes by A. W. Hofmann: this is the cause of the quantity of precipitated sulphur being less than it ought to be. By a direct determination 12 per cent S were found, while the formula for the three molecules S requires 13·4 per cent S.

On trying to concentrate the lye over sulphuric acid, it is decomposed, losing its colour, and separating sulphur. The liquid contains hyposulphites and sulphates.

By concentrating the yellow lye in a flask, boiling all the while, it is coloured yellowish brown. A considerable precipitate is formed, consisting chiefly of calcium sulphite mixed with calcium hydrate and sulphate. On cooling, the liquid assumes the original colour, and behaves exactly like the original lye. With alcohol the yellow scales and needles are formed; after protracted standing they separate in such quantity that the fluid resembles a paste. While the crystals formed from normal lye are stable in contact with it, the crystals in the concentrated lye are decomposed after standing for weeks, if the air is not completely excluded, the lye not losing its colour. If the lye, which has been mixed with alcohol, and thereby freed to a certain degree from oxytetrasulphuret, is again mixed with absolute alcohol until no more precipitate is formed, the latter is yellow in the beginning, but soon becomes quite white. It is insoluble in water, and easily purified by washing; it completely dissolves in hydrochloric acid with the evolution of sulphurous acid, and the analysis proves it to be, beyond doubt, calcium sulphite. It yielded dry 42·33 per cent lime, $CaSO_3+\frac{1}{2}aq.$, requires 43·4 per cent lime. The last parts of the precipitate, especially if a large excess of alcohol had been added, contain calcium hyposulphite, which has been formed by decomposition from the sodium salt.

The precipitated sulphite does not re-dissolve, even if added to large quantities of fresh lye, after prolonged action. It is not impossible that this peculiarity may be explained by the fact that the calcium sulphite does not exist in the lye in the free state, but in combination with another sulphur compound, which is decomposed by a change of the solvent. The existence of such compounds of calcium sulphite has been proved by Kuhlmann, who observed the compound $CaSO_3+2CaS+6aq.$, in the form of fine yellow crystals in old heaps of soda waste.

If the lye which has been precipitated with alcohol is left to stand in a closed flask for several months, not inconsiderable quantities of fine and well-formed crystals of sodium hyposulphite are formed. Other acids of sulphur, besides sulphurous, hyposulphurous, and sulphuric acids, were not present in the lye; at least, after treating the lye with carbonic acid until all sulphuretted hydrogen was driven off, none of Kessler's reactions for tetrathionic and pentathionic acids could be obtained. The reactions for trithionic acid, indicated by hyposulphurous acid, which behaves exactly like trithionic acid; this is proved by the fact, that after completely decomposing the lye with hydrochloric acid, only traces of sulphuric acid are found, which ought to have been present in larger quantities as the product of the decomposition of trithionic acid.

By passing carbonic acid through the sulphur lye, until no more decomposition takes place, and all sulphuretted hydrogen is driven off, then boiling for a short time, in order to precipitate the dissolved calcium carbonate, after filtering, a yellowish precipitate and a colourless filtrate are obtained. The former consists of pure calcium carbonate and sulphur; the latter contains little sodium carbonate and larger quantities of sodium hyposulphite, which on concentration crystallises entirely free from lime. By this operation the sodium sulphur compounds of the lye are converted into carbonate, which decomposes the calcium sulphite (which has been converted into hyposulphite), precipitating calcium carbonate. The excess of sodium carbonate remains in the lye.

If the same experiment is made with the lye, from which the excess of calcium salts has been removed by alcohol, a precipitate of pure calcium carbonate and sulphur is likewise formed; the filtrate has a yellow colour from dissolved sulphur, and turns olive-green when heated; mixed with water it becomes colourless with the separation of sulphur, and after evaporation it also yields crystals of sodium carbonate and hyposulphite, which are free from lime. Analysis, however, showed the quantity of sodium carbonate to be much more considerable, for the calcium sulphite has been precipitated by the alcohol, and therefore is not, as in the former case, decomposed by the sodium carbonate, whose quantity is correspondingly larger.

Bisulphide of carbon extracted from the lye a considerquantity of sulphur, a proof that the lye contained free sulphur in solution, *i.e.* dissolved by the calcium polysulphurets. The lye can dissolve still more sulphur, as is shown by the sulphur, which has been precipitated by a few drops of acid, being re-dissolved by agitating.

By adding solution of protoxide of maganese to the lye, sulphuretted hydrogen was evolved, a proof of the presence of sulphhydrates—here sodium and calcium sulphhydrate. Further analytical experiments justify the assumption, that besides those compounds, whose presence has been directly proved, calcium pentasulphide is contained in the lye. Therefore the lye contains:

$$CaS_5;\ 4CaO,CaS_4+18aq;\ CaSO_4;\ CaSO_3;\ Na_2S_2O_3;\ NaHS;\ CaH_2S_2;\ S.$$

In order to ascertain the relative quantities of the different compounds, the following determinations, to be described hereafter, were made: Sulphurous, hyposulphurous, and sulphuric acids, and the sulphuretted hydrogen of the sulphhydrate, all the sodium and calcium, the total amount of sulphur, and finally the sulphur and calcium, which were precipitated by carbonic acid, were determined. From the numerical results the compounds could be established and calculated.

(To be continued.)

PYROLOGY, OR FIRE ANALYSIS.*

By Captain W. A. ROSS, R.A.

1. PYROLOGY, as distinguished from ordinary blowpipe manipulation, may be described as the art of inducing chemical changes in substances from which their *composition*† can be concluded, by the scientific application to them of fire, and the use of *acid* as well as alkaline fluxes for purposes of solution and of separation.

2. The term "pyrocone" is used instead of that of "flame," employed by writers on the blowpipe, which last expression is here only applied to flames without a definite shape (*vide* paragraph 25), both because such a distinction is evidently a more correct phraseology, and because it prevents otherwise unavoidable confusion when both kinds of fire are produced in the same operation. For similar reasons the word "blowpipe," which seems a coarse and inexpressive appellation, equally applicable to a pea-shooter and the tubes of an organ, will be relinquished in these pages for the term "pyrogene."

Pyrocones.

3. Pyrocones are divided into two classes, (*a*) natural and (*b*) artificial; *a* is the shape candle and other flames

* Communicated by the Author. From the *Proceedings of Royal Society.*

† In the term *composition* is included the quantitative as well qualitative estimation.

assume in air when left to themselves; *b* is that formed by treating *a* artificially as follows:—

4. On the application of a fine jet of air or breath, such as is impelled by operators with the pyrogene, to one side of the base of the natural pyrocone, the unburned gases in the centre are apparently expelled; the luminous cone, unless the blast is too weak, entirely vanishes, and what now appears is a long *solid* tongue of blue light, terminating in a point of needle-like fineness with a violet-

Fig. 1.

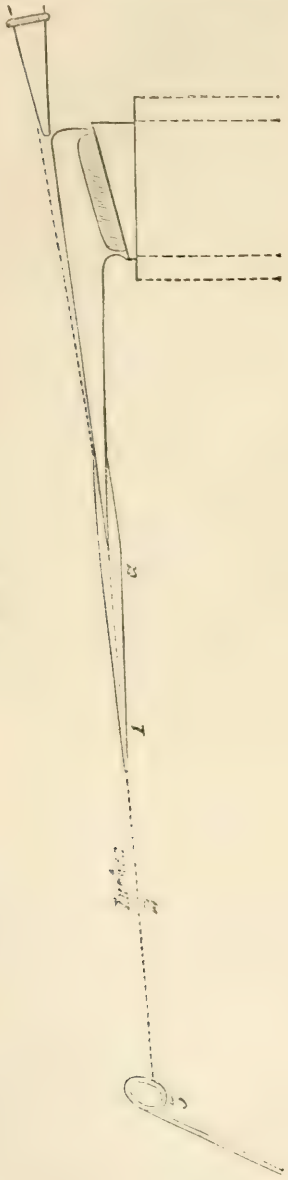
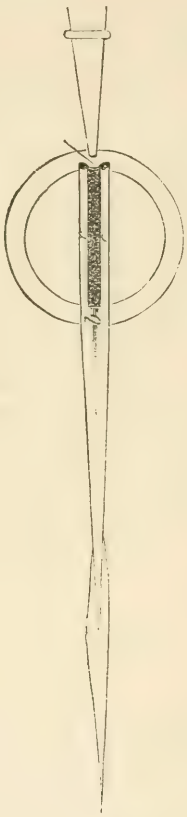


Fig. 2.

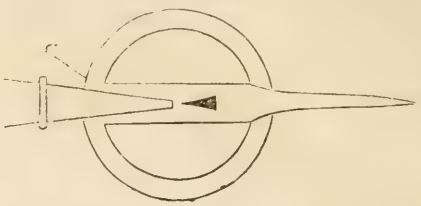


coloured cone enveloping the apex, and extending, with a more obtuse termination beyond it, to a distance commensurate with the strength of the blast.

5. If we take the natural pyrocone afforded by ignited spirits or other light hydrocarbon producer, and blow into the centre of it with a mouth pyrogene, the jet of which is kept at some distance from one side of the cone, we observe two *synaxial* pyrocones formed by the blast, the bases of which are contracted or enlarged proportionately with its strength or weakness. If we approach the jet of the pyrogene so as to touch the side of the spirit-lamp pyrocone, and blow with greater violence, the inner or blast cone becomes invisible from the accelerated movement of the air; but we must analogically conclude that its basic diameter is contracted, and its length extended proportionately with those changes in the outer or *visible* pyrocone.

6. That the air or breath from the pyrogene is driven *through* the longitudinal axis of the artificial spirit-pyrocone is also easily proved by the operator blowing with

Fig. 3.



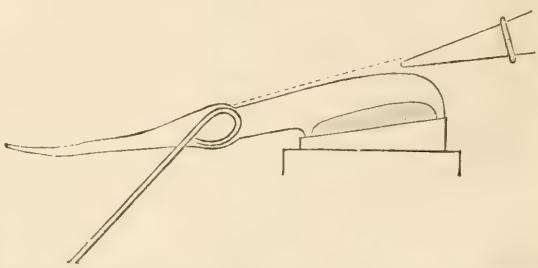
still greater violence, when the apex of the cone will be observed to be broken up by the blast at the under extremity, the sides remaining intact, so that the form is now that of a hollow cylinder.

7. Very different is the pyrocone produced by the attempt to blow into the natural one afforded by the flame of ignited oil,* wax, coal-gas (not previously mixed with air as in the Bunsen burner), or other dense hydrocarbon. The blast cone no longer penetrates the blue flame, but moves *above* it, drawing out, as it were telescopically, a *solid* pyrocone from under its base, so that the two cones are no longer synaxial, but conjunctive (Fig. 1).

8. If we view this pyrocone from above, the diagram (Fig. 2) is something like what we see. All ascending heat from the lamp is completely stopped; whereas we could not view the spirit-pyrocone from a like position without burning the face, because in the first case the natural pyrocone is bent, as it were, under the blast, but in the second merely bored through by it.

9. It will be seen from Fig. 2 that the hollow nucleus of the natural pyrocone, which we have assumed to be filled with unburned gases, is traversed over its whole length by

Fig. 4.



the blast cone from the jet, showing the wick of the lamp underneath as a black band, the breadth of which is directly proportional to the diameter of the base of the blast cone, and therefore inversely so to the strength of the blast, which, blowing in the short side, *a*, of the blue or hydrocarbonous perimeter, *into* its long sides, *c c*, causes these latter to rise slightly like flame-walls on either side, and draws them along with it until they combine at *b* to form a solid pyrocone underneath it, as above described.

10. If the short side, *a*, be burst by the insertion of the jet, instead of by the blast, the shape of the latter, as seen from above over the wick, is that represented in Fig. 3, the

* Cocoa-nut oil (if it be perfectly pure) affords by far the best pyrocone, and coal-gas almost the worst, for the purposes detailed in paragraph 15.

size and power of the resulting pyrocone being immensely diminished.

11. If, therefore, the blast in pyrological operations were driven *through* the long axis of the oil- or gas-lamp artificial pyrocone, as is generally assumed, and as is undoubtedly the case with the *spirit*-cone, we could not (1) see the lamp-wick as through a *transparent* medium like air, and (2) the heat ascending from the upper part of the pyrocone would be felt upon the face of the operator stooping over it; but it must be here observed that, to produce these effects, the volume and strength of the blast must bear a certain proportion to the size of the natural pyrocone.

12. It would be reasonable to expect from the above that the spirit- and oil-lamp pyrocones should possess different properties, and this is the fact. The pyrogenical or artificial cone of the former cannot, or can but feebly, attain the results produced by the latter. Filled with breath-vapour, instead of being solid, it has too much heating-power, while the enclosed gases interfere both with the oxidation and the reduction of the subject of analysis.

13. It follows, also, from a consideration of Fig. 2, and the facts detailed in par. 9, that the central portion of the wick or fuel in ordinary pyrological lamps is unutilised; and in fact if an oil-lamp be used having two thin wicks instead of one thick one, and these be slightly pressed apart in the front (as at *a*, Fig. 2), it will be found that a pyrocone of nearly double power will be produced by a similar blast and expenditure of fuel.*

14. Keeping the assumed fact of the superincumbency of a blast cone, and the consequent solidity of the blue pyrocone underneath, in remembrance, we can readily understand that a roundish object placed in the latter about the centre of its longitudinal axis, which has a diameter equal to or less than that of the pyrocone, will be wholly enveloped by the ignited gas or gases of which the cone is composed, so as to form a kind of bulb or jacket round the front, *i. e.*, that side towards the base of the pyrocone whence the current proceeds. The object is thus apparently preserved from communication, not only with atmospheric oxygen, but with unignited gas of any kind. Such an envelopment is termed—

The Hydrocarbonous Pyrocone (Symbol H. P.) (Fig. 4).

15. The behaviour of different substances when held steadily in the hydrocarbonous pyrocone causes it to be a synthetical and analytical agent of great value to the pyrologist. Substances of a viscid nature (not salts), as phosphoric or boric acid, become coated, after a few minutes' insertion, with a shining lustrous film having an extraordinary resemblance to a metal,† which, when gold or silver oxides are previously dissolved in the former bead, becomes tinged with yellow in the first case, and with a silvery shade in the second, much as alloys of those metals would. This film evidently increases in thickness according to the length of time it is immersed in the hydrocarbonous pyrocone, for after a short immersion the glass is still semitransparent; but when held a longer time it becomes opaque.

16. The film thus formed is very hard, being unsusceptible to the point of a penknife. It has no taste, or, if any, that of a metal, while the taste of the oxidised phosphoric acid is sharp and acidulous. After the application of the tongue, an iridescent tarnish is left like that of sulphur upon silver; in fact none of these films will stand long exposure to a damp atmosphere. They are so very thin and hard that it seems impossible to remove any portion from the glass (which remains vitreous in the inside) with the forceps, or even by breaking up the whole bead.

17. Sulphur, in the viscid or red and resinous state, is also changed by this treatment to a metallic appearance on its outer surface; but to produce this reaction the pyrocone must be very perfect and of an unmodified blue colour, or the sulphur will be at once ignited and burn away. When once prepared in this way sulphur has no further tendency to burn, and it then has the remarkable property of giving, in a glass of phosphoric acid, reactions similar to those of copper, viz., green hot, and blue-green cold after treatment with a peroxidating pyrocone (to be hereafter described); but green hot and cold after a reducing pyrocone has been applied.* Ultramarine might owe its blue colour to this fact.

18. When a roundish mass of silica or alumina, or of both combined, is held in the hydrocarbonous pyrocone, it becomes quite black; and as this blackness is not merely on the surface, but throughout the mass, it would appear to be due to a decomposing effect exerted by the latter upon the pyrocone itself, and not a mere deposition of soot, which might have been supposed to have been mechanically carried along by the blast upon its surface. Alumina, however, appears to become partially fused, and thus forms into roundish or botryoidal swellings, while silica presents a steel-black mass to the lens with shining metallic-looking points in it. These two omnipresent and almost universally combined earths, therefore, may be thus pretty correctly and extremely rapidly distinguished.†

Alkaline Earths in H. P.

19. Lime, strontia, and, to some extent, baryta and magnesia, are not thus carbonised by treatment with the hydrocarbonous pyrocone, and may therefore, when pure, be easily thus distinguished from the two first-mentioned earths. For lime, especially, a quantitative assay may be approximately made by slaking the mass thus treated in distilled water, when it will remain dark or grey or white, according as the lime exists in lesser or greater proportion. Above 80 per cent of lime will cause the mass to remain perfectly white. The oxide of iron does not interfere with this reaction.

20. This property, which lime possesses, of remaining perfectly white and of resisting all tendency to reduction during such treatment, renders it an excellent medium for the detection of chlorides and fluorides, which seem to separate after a time from the lime, and to form some combination with the carbon of the pyrocone, the lime having no such tendency; for instance, in chloride of calcium, after a few minutes of this treatment, a small black patch, round in proportion to the sphericity of the mass, is formed on the side next the current of blue flame, which can be easily seen through the lens to be not soot, and seems to have a sweet taste; but if such a mass be often quenched in distilled water, and as often re-treated in the hydrocarbonous pyrocone, the black patch will shortly assume a metallic and white appearance.

21. Fluorides after the above treatment exhibit an irregularly-shaped patch, also next the direction of the hydrocarbonous current; but this patch, instead of being black, has a changeable green colour, like some of the aniline compounds, and, after some quenching with water, a metallic appearance, but still green.

22. A very curious result is obtained by the treatment of bicarbonate of soda in the hydrocarbonous pyrocone. After a short time violent ebullition commences in the melted bead; bubbles of some (carbonic acid?) gas are seen to rise with great rapidity through it while red-hot. In this state of violent ebullition fragments are projected from the mass, which, when examined through a lens, are found to be black hollow spheres like microscopic shells. Notwithstanding the loss occasioned by the ejectment of these projectiles, the mass, if now carefully examined by a lens, will be found to consist partly of caustic soda, and partly of a black substance, solid, and even angular and shining like a piece of coal. This substance is proved to be carbon by its deflagration when heated with nitre, and its formation is proved to be not due to a deposition of

* Messrs. Price and Co. have manufactured, to the order of the writer, pyrological candles with a double wick on this principle.

† These films are difficult to produce with coal-gas, on account of its general impurity. *Vide* par. 4.

* These effects are only in part producible by a gas-pyrocone. *Vide* pars. 4 and 7.

† The writer, by compressing the tip of the platinum jet, so as to form a slit there, instead of a round orifice, produced a very perfect H. P.

soot from the lamp-flame, by the fact that the similar treatment of chloride of sodium will produce no such result.

23. If any of the "earths" be held on platinum-wire after being made into a paste with a little distilled water in a hydrocarbonous pyrocone, those which carbonise in such a situation, as alumina and silica, being slightly heated in an oxidating pyrocone for a few seconds so as to just burn off the carbon, and if the mass be then saturated with cobalt solution, lime and strontia will immediately turn a distinct blue; and of these two, if allowed to remain exposed to the air for a time, the lime will slowly turn green, the strontia brown.* The previous addition or existence of iron sesquioxide will cause these to turn, instead of blue, green in the first instance. All the other earths, if pure and not in a chemically caustic state, become pink with cobalt solution; and if then they are approached carefully to the natural pyrocone of a spirit-lamp, this pink colour deepens to a rich carmine.† Of these earths, alumina and magnesia will (as is known), when treated with a peroxidising pyrocone, change, the first to a deep blue, the second to a pale flesh or salmon-colour. Silica in this case turns a distinct purple, even in presence of oxide of iron; lime, baryta, and strontia, a grey or grey-black. We thus obtain a nearly new chromatic series between the common "earths" of considerable value in analysis, as follows:—Lime (*a*) and strontia (*b*) *blue*, changing on exposure to air (*a*) to green and (*b*) to brown. Alumina (*a'*), silica (*b'*), baryta (*c'*(, and magnesia (*d'*), *pink*, changing on treatment with a peroxidising pyrocone (*a'*) to blue, (*b'*) to purple, (*c'*) to grey-black, and (*d'*) remaining pink.

24. Berzelius, and after him Plattner and other writers on blowpipe analysis, tell us we "are not to take notice of any changes of colour in a substance to which cobalt solution has been applied *previous* to the further application to it of an oxidating flame; for the colour imparted, blue, red, or black, proceeds from the cobalt solution only, and not from any of the ingredients;" from which statement it is evident that we have hitherto lost some of the most valuable qualitative indications of cobalt, due to the important fact that lime and strontia are rendered caustic by much less heat than the other "earths," and therefore dehydrate the cobalt solution after treatment with a hydrocarbonous pyrocone, rendering it blue, which none of the other earths will do. If the colours "proceed from the cobalt solution only," how is it that lime turns *blue* and baryta *red* when it is thus applied?

(To be continued.)

* Fluoride of calcium *remains* blue.

† Oxide of *zinc* thus treated affords a beautiful peach-colour; oxide of *tin*, after P. P., a green.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, January 27, 1873.

This number contains the following original papers relating to chemistry:—

Preservation of Alimentary Substances by the Application of Great Cold.—Professor Boussingault.—The author states that a quantity of beef-tea having been submitted some eight years ago to a temperature of −20° for several hours, has remained in perfectly good condition up to the present time. Sugar-cane juice was at the same time subjected to this treatment, and was found to be in excellent condition. Both substances had of course been kept in closed vessels.

Determination of the Boiling-Point of Liquefied Sulphurous Acid Gas.—I. Pierre.—While referring to some experiments made by Professor Melsens, the author states that twenty-six years ago he gave a detailed account (see *Ann. de Chimie et de Phys.*, 3rd series, vol. xxi.) of a process by means of which the boiling-point of the liquefied gas may be readily ascertained.

Researches on the Allotropic Transformations of Phosphorus.—L. Troost and P. Hautefeuille.—This exhaustive monograph treats on the relation existing between the temperature and pressure as bearing upon the conversion of ordinary phosphorus into its allotropic modification.

Application of the Monochromatic Light Produced by the Sodium Salts for Ascertaining the Change of Colour of Tincture of Litmus in Alkalimetrical Assays.—L. D'Henry.—The description of a Bunsen gas-burner so arranged that the flame is kept constantly saturated with sodium, so that while the blue colour of litmus appears deep black, the red colour, produced by the addition of an acid, appears as colourless as water; thus affording a better means of ascertaining the precise moment when the alkali is saturated.

New Tertiary Alcohol, and on a Method of Preparing a Series of Tertiary Alcohols.—C. Friedel and R. D. Silva.—This essay, elucidated by a series of complex formulæ, treats on pinacone, pinacoline, and on the combinations thereof among these dimethyl-isopropyl-carbinols.

Commercial Assay of Nitrates.—H. Joulie.—Reserved for translation.

Spontaneous Alteration of Eggs.—U. Gayou.—The author comes to the conclusion that the main cause of the decomposition of eggs is the presence of small organisms which must have formed in the egg while in the oviducts of the fowl.

Analysis of Arite from the Ar Mountain (Basses Pyrénées).—F. Pisani.—The mineral just named is amorphous, sp. gr. 7·19; composition in 100 parts—Sulphur, 1·7; arsenic, 11·5; antimony, 48·6; nickel, 37·3; zinc, 2·4; total, 101·5. Formula, $Ni_2(Sb,As)$.

Polytechnisches Journal von Dr. E. M. Dingler, first number for January, 1873.

On the Technical Mode of Estimation of the Quantity of Oxygen Present in Gaseous Mixtures, and Description of two Newly-Devised Apparatus for the Purpose of Analysis of Gases.—Max. Liebig.—This essay, illustrated with engravings, treats on a method more particularly adapted for the qualitative and quantitative determination of oxygen present in the gases which leave the vent of sulphuric acid chambers. A detailed description of apparatus suitable for this purpose and for gas analysis generally is also given.

New Method of Assaying Lead Ores.—A. Mascazzini.—Previous to reducing the galena or other lead ore to the metallic state, the author converts the lead present in the ore into sulphate, by igniting it in a porcelain crucible with sulphate of ammonia, after which the ore is treated in the usual manner. The flux preferred by the author is that recommended by Plattner, consisting of—13 parts of carbonate of potassa; 10 of dry carbonate of soda; 5 of previously fused borax; and five of well-dried starch.

Process of Recovering in the shape of Alum the Potassa used in the Calico Printing Dyes and Pigments.—Cylinder Printing.—E. Schlumberger.

Preparation of Chlorates by the Aid of Chlorate of Alumina.—J. von Brandt.—The contents of this paper bear more strictly upon the preparation of aniline black. The chlorates of ammonia, alumina, and lime are obtained by a circuitous process with the aid of chlorate of potassa.

So-Called Chemical Carbon as used in Calico Printing Works.—E. Kopp.—This material is obtained by treating lamp-black with concentrated sulphuric acid, and afterwards thoroughly washing it with water. The finely-divided and dried material is used as a pigment, and found to contain, after having been dried at 120° (loss thereby 4·96 per cent moisture), in 100 parts:—Carbon, 80·25; hydrogen, 1·75; oxygen, 14·12; ash, 3·88. This substance is readily acted upon at 100° by ordinary nitric acid, and in the cold by strongly fuming nitric acid. The result of this reaction is the formation of an amorphous, deep yellow-coloured, and stringent matter.

Gazzetta Chimica Italiana, Nos. 8 and 9 (double number), 1872.

The Purple Pigment of the Ancients, and the Colouring-Matter found on the Vase of St. Ambrosius at Milan.—A. Bizis.—This exhaustive historico-chemical essay is devoted to the record of a series of experiments on indigo and other pigments for the purpose of comparing the reactions they exhibit with those of the purple of the ancients, as described in a work published under the following title.—"Dissertatione Sopra la Porpora Antica, e Sopra la Scoperta Della Porpora nei Murici, Venetia, 1843. The author of this essay thinks that the pigment found on the vessel alluded to is derived from the purple, which he states was still preserved and used for dyeing purposes at the time of Charlemagne, ninth century.

On Two Nitrophenol-Sulphuric Acids.—W. Koerner.—This monograph is divided into the following sections:—Indentity of Kolbe's and Gauhe's nitrophenol-sulphuric acid with Kekulé's; orthonitrophenol-sulphuric acid; salts of that acid.

On Iodo-Benzol Para-Sulphuric Acid.—W. Koerner.—After referring to the researches of Wurtz, Kekulé, Vogt, Oppenheim, and

others, the author describes at length the mode of preparation of iodo-benzol para-sulphuric acid, a very deliquescent body which forms crystalline compounds with potassa and baryta, and a white pulverulent, silky, shining combination with lead. By fusion with caustic potassa iodo-benzol para-sulphuric acid yields resorcin.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 1, 1873.

This number contains the following original memoirs:—

Basicity (Basicität) and Constitution of Superiodic Acid.—J. Thomsen.—A thermo-chemical essay elucidated by a series of diagrams and tables.

Preparation of Sulphuryl-Chloride, SO_2Cl_2, from Sulphuric Anhydride and Chloride of Boron.—G. Gustavson.—In the introduction to this paper the author gives a brief *resumé* of the labours of Schützenberger, Michaelis, Odling, Williamson, and others on the action of sulphuric anhydride upon the chlorides of the metalloids. The best proportions for the preparation of sulphuryl-chloride by the reaction of sulphuric anhydride upon chloride of boron is 1 equivalent of the latter to 2 of the former, to be heated together in a sealed tube to 120° for about eight hours; the result is the formation of sulphuryl-chloride, a fluid boiling at between 70° and 71°, decomposed by addition of water, yielding sulphuric and hydrochloric acids, and consisting, in 100 parts, of 52·59 of chlorine and 23·70 of sulphur. The reaction is exhibited by the following formula:—

$$2BCl_3+4SO_3=3SO_2Cl_2+B_2O_3.SO_3.$$

The last-mentioned compound, viz., a combination of boric acid with sulphuric anhydride, is a solid material, which, when thrown into water, gives rise to a violent reaction, resulting in the formation of crystalline boracic acid and dilute sulphuric acid. Sulphuryl-bromide cannot be obtained from bromide of boron and sulphuric anhydride by a similar process; but[when silicium chloride and sulphuric anhydride are submitted to the same process, there is formed $S_2O_5Cl_2$.

Dissociation of the Oxide of Mercury.—J. Myers.—Reserved for translation.

Some of the Nitrogen Compounds of Anthrachinon.—R. Bœttger and T. Petersen.—This essay treats on the nitration of anthrachinon, and on α-mono-nitro-anthrachinon, $C_{14}H_7(NO_2)O_2$, a solid yellow-coloured substance, crystalline when sublimed, fuses at 230°, insoluble in water, barely soluble in ether, difficultly so in alcohol, but readily soluble in acetic ether, benzol, chloroform, oil of turpentine, glacial acetic acid, concentrated sulphuric acid and aniline, with which it combines; and this compound dissolves in acetic acid and ethereal solvents, exhibiting a most brilliant magenta colour. α-mono-nitro-anthrachinon is readily converted into the α-dinitro-anthrachinon by the action of nitrosulphuric acids, while, when the first-named substance is fused with caustic alkali, a large quantity of alizarine is formed. α-monamido-anthrachinon, $C_{14}H_7(NH_2)O_2$, a brick-red coloured powder, crystalline by sublimation, fusion-point 256°, difficulty soluble in alcohol and ether, but more readily so in chloroform, acetic ether, benzol, glacial acetic acid, and in concentrated sulphuric acid. α-diazo-anthrachinon, $C_{14}H_7N_2O_2.NO_3$, is a crystalline compound, soluble in water, which, by being heated with water, gives off nitrogen. The last portion of this essay treats at length on the behaviour of α-mono-nitro-anthrachinon with concentrated sulphuric acid. In an appendix, the authors state that anthrachinon or mono-nitro-anthrachinon can be directly nitrated, forming α-dinitro-anthrachinon by boiling with the so-called *acidum nitroso-nitricum* (sp. gr., 1·52). Nitric acid of 1·44 sp. gr. does not attack even dissolved anthrachinon at boiling heat. The mode of preparation of the compounds described is given in detail.

Red Colouration of White-Lead.—J. Lorscheid.—The author first refers to the paper on this subject by Bannow and Kraemer (see CHEMICAL NEWS, vol. xxvi., p. 35), and then states that about seven years ago he investigated this subject, having a large quantity of the red-coloured material to operate upon. In the main, the researches of the author and the other scientific chemists agree that the colour is not due to foreign metals, but to oxygen compounds of lead, including peroxide, but excluding the carbonate. The cause of the origin of the red colour is due to a deficiency of carbonic acid, and this is elucidated by the communication of some practical details relating to the making of white-lead.

Some of the Derivatives of Aceton.—A. Emmerling.—This essay treats on mono-bromaceton, the monoxy-derivative thereof, and on the relation existing between the carbohydrates and the oxy-derivatives of aceton.

Preparation of Fuchsine.—A. Brüning.—Fuchsine is industrially prepared by the author without the aid of arsenic acid, the reaction of nitrobenzol upon aniline being substituted for the acid. The fuchsine so prepared is in every respect like that prepared with arsenic acid, and can be produced equally cheap.

Sulphuretted (Geschwefelte) Tannic Acid from Phloroglucine.—H. Schiff.—The first portion of this essay treats on the action of pure disulphurylic acid upon anhydrous phloro-glucine, the result being the formation of a crystalline sulpho-acid which forms, with alkalies and the alkaline earths, soluble salts. The sulpho-phloroglucinic acid is isomeric with sulpho-gallolic acid (*sulfogallol saure*). Oxychloride of phosphorus acts upon the former in the same manner as on the latter. The second part of this paper, elucidated by a series of formulæ, records at length the rather complex mode of preparation of sulpho-tannic acid from the other compounds mentioned above.

Experimental Trials made for the purpose of Preparing Methyl-Ethyl-Acetic Acid, and Synthetical Preparation of a Suberic Acid-Ethyl-Ester (Kork-saure-ethyl-ester).—C. Hell.—This monograph is divided into the following sections:—Monobrom-butyric acid-ethyl-ester; iodo-butyric acid-ethyl-ester; suberic acid-ethyl-ester.

On Pentachlorbenzols.—H. Ladenburg.—This paper records the determination of the boiling-points of some samples of pentachlorbenzol made by different chemists, and found in collections of chemical preparations, the aim being to try whether there exists more than one pentachlorbenzol, as stated by Jungfleisch. The boiling-points of these samples varied from 210° to 225°. In the concluding portion of this paper, the author corrects errors made by Jungfleisch in his paper published in the *Bull. de la Soc. Chim. de Paris*, concerning his (Ladenburg's) researches on pentachlorbenzol.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, February, 1873.

In addition to several memoirs bearing upon practical mechanics, this number contains the following papers relating to chemistry and collateral subjects:—

Mushet Steel.—J. Gruner.—A detailed account of the author's researches on the steel produced at Coleford (Gloucestershire) by the Titanic Forest Steel Works. In the hard metal, the author found—Silicium, 0·005; titanium, 0·002; carbon, 0·030. In the malleable metal—Silicium, 0·005; titanium, less than 0·002; carbon, 0·015. Another sample of Mushet's steel was found to contain no titanium, but as much as 8 per cent of tungstenum.

Normal Composition of Glass; Analysis of a Memoir by E. Banrath.*—H. de Fontenoy.—An exhaustive monograph, elucidated by a large number of tables exhibiting the detailed results of analyses of glass made by different authors during a period of sixty years, with quotations of the periodicals in which these results are published.

Although not relating to chemistry, we notice, from the proceedings of the meetings of this Society, a communication on—

Goïtres.—P. Thomas.—According to some practical proofs, the author believes that goïtres is due to the absolute absence of iodine from natural waters used in mountainous countries. These researches certainly deserve attention, for it appears that water coming in contact with cupreous pyrites, or the products of its oxidation, becomes absolutely free from iodine and its compounds.

The American Journal of Science and Arts, January, 1873.

The only original memoir relating to chemistry and published in this number is the continuation of a monograph on—

Researches in Actino-Chemistry.—J. W. Draper.

Les Mondes, January 30, 1873.

This number contains no original matter relating to chemistry, but we call attention to the following essay:—

Theory of the Formation of the Earth's Surface, Sketched in its main Characteristic Features.—J. Le Conte.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, September and October (double number), 1872.

This number contains no papers relating to chemistry.

Bulletin de la l'Academie Imperiale des Sciences de St. Petersbourg, vol. xviii., No. 2, November, 1872.

This number does not contain any original paper relating to chemistry.

MEETINGS FOR THE WEEK.

MONDAY, Feb. 10th.—Medical, 8.
—— Geographical, 8½.
—— London Institution, 4.
TUESDAY, 11th.—Civil Engineers, 8.
—— Photographic, 8. (Anniversary.)
—— Royal Institution, 3. Prof. Rutherford, "On Forces and Motions of the Body."
WEDNESDAY, 12th.—Society of Arts, 8.
—— London Institution, 1.
THURSDAY, 13th.—Royal, 8½.
—— Royal Society Club, 6.
—— Royal Institution, 3. Dr. Armstrong, "Formation of Organic Substances."
FRIDAY, 14th.—Astronomical, 3. (Anniversary.)
—— Royal Institution, 8.
—— Quekett Club, 8.
—— Royal Institution, 9. Mr. R. H. Scott, "On the Progress in Weather Knowledge."
SATURDAY, 15th.—Royal Institution, 3. Edward A. Freeman, D.C.L., "On Comparative Politics."

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* "Die Normal Zusammensetzung Bleifreien Glases und die Abweichungen von der Selben in die Praxis." Von Benrath. Aachen (1868): Druck von Georgi.

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A. H. Allen, T. Wardle, J. Roberts, and W. Briggs are thanked for their communications. We will send them more particulars shortly.

THE

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Edited by WILLIAM CROOKES, F.R.S., &c.

No. XXXVII., *January*, 1873, price 5s.

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I. On the Probability of Error in Experimental Research. By William Crookes, F.R.S., &c.
II. Gold Mines and Milling of Gilpin County, Colorado, United States. By James Douglas, Quebec.
III. Condition of the Moon's Surface. By R. A. Proctor, B.A., F.R.A.S. (With Page Photograph).
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VI. Remarks upon the Present State of the Devonian Question. By Horace B. Woodward, F.G.S.

Notices of Books. Progress of the Various Sciences, &c., &c.

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and how used in dyeing? also, how is Blackley red made?—P. BURROWS.

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RESEARCHES IN SPECTRUM ANALYSIS IN CONNECTION WITH THE SPECTRUM OF THE SUN.—No. I*

By J. NORMAN LOCKYER, F.R.S.

THE author, after referring to the researches in which he has been engaged since January, 1869, in conjunction with Dr. Frankland, refers to the evidence obtained by them as to the thickening and thinning of spectral lines by variations of pressure, and to the disappearance of certain lines when the method employed by them since 1869 is used. This method consists in throwing an image of the light-source to be examined on to the slit of the spectroscope.

It is pointed out that the phenomena observed are of the same nature as those already described by Stokes, W. A. Miller, Robinson, and Thalen, but that the application of this method enables them to be better studied, the metallic spectra being clearly separated from that of the gaseous medium through which the spark passes. Photographs of the spark, taken in air between zinc and cadmium and zinc and tin, accompany the paper, showing that when spectra of the vapours given off by electrodes are studied in this manner, the vapours close to the electrode give lines which disappear from the spectrum of the vapour at a greater distance from the electrode, so that there appear to be long and short lines in the spectrum.

The following elements have been mapped on this method;—Na, Li, Mg, Al, Mn, Co, Ni, Zn, Sr, Cd, Sn, Sb, Ba, and Pb, the lines being laid down from Thalen's maps, and the various characters and lengths of the lines shown.

In some cases the spectra of the metals, enclosed in tubes and subjected to a continually decreasing pressure, have been observed. In all these experiments the lines gradually disappear as the pressure is reduced, the *shortest lines disappearing first, and the longest lines remaining longest visible.*

Since it appeared that the purest and densest vapour alone gave the greatest number of lines, it became of interest to examine the spectra of compounds consisting of a metal combined with a non-metallic element. Experiments with chlorides are recorded. It was found in all cases that the difference between the spectrum of the chloride and the spectrum of the metal was that under the same spark-conditions all the short lines were obliterated. Changing the spark-conditions, the final result was that only the very longest lines in the spectrum of the metallic vapour remained. It was observed that in the case of elements with low atomic weights, combined with one equivalent of chlorine, the numbers of lines which remain in the chloride is large, 60 per cent., *e.g*, in the case of Li, and 40 per cent in the case of Na; while in the case of elements with greater atomic weights, combined with two equivalents of chlorine, a much smaller number of lines remain—8 per cent in the case of barium, and 3 per cent in the case of Pb.

The application of these observations to the solar spectrum, to elucidate which they were undertaken, is then given.

It is well known that all the known lines of the metallic elements on the solar atmosphere are not reversed. Mr. Lockyer states what Kirchhoff and Angström have written on this subject, and what substances, according to each, exist in the solar atmosphere. He next announces the discovery that, with no exception whatever, *the lines which are reversed, are the longest lines.* With this additional key he does not hesitate to add, on the strength of a small number of lines reversed, zinc and aluminium (and possibly strontium) to the last list of solar elements given by Thalen, who rejected zinc from Kirchhoff's list, and agreed with him in rejecting aluminium. It need scarcely be added that these lines are in each case the longest lines in the spectrum of the metal.

The help which these determinations afford to the study of the various cyclical changes in the solar spectra is then referred to.

* Abstract of a paper read before the Royal Society.

DR. MORFIT'S WORK ON MINERAL PHOSPHATES.

By E. ESILMAN.

THERE is no doubt that whoever can rid mineral phosphates of the alumina and oxides of iron they contain, utilising the phosphoric acid with which they are combined, will master a problem the solution of which is daily becoming more and more desirable. Phosphates of iron and alumina are not admitted to be equal in manurial efficacy to phosphate of lime, and when made soluble in a manure render it liable to become damp. Many attempts have been made to overcome this objection to the use of many native phosphates, the latest of which is that of Dr. Campbell Morfit, described in his work entitled "Mineral Phosphates and Pure Fertilisers." On referring to this book, I found his method to consist in the fractional precipitation of hydrochloric acid solutions of impure phosphates by means of lime, or precipitated ferric or aluminic oxides or phosphates, so manipulating as to obtain a precipitate of dicalcic phosphate, almost pure, and a mother-liquor containing chloride of calcium, and phosphates of alumina and iron dissolved in hydrochloric acid. Not being able to find analyses of these products in the work referred it, I was induced to carry out the process on the small scale, so as to judge of its merits, but found myself unable to prepare a pure phosphate of lime, though working according to the instructions of the book. Solutions of bone-ash and Suffolk coprolites, made by treating them with hydrochloric acid slightly in excess of that required to dissolve carbonates and phosphates, on being boiled with pulpy phosphate of alumina (precipitated by ammonia) added, till a decided precipitate formed, gave me only phosphate of alumina, not a trace of phosphate of lime being found in the washed insoluble precipitate. The only action seemed to be the conversion of the gelatinous tribasic phosphate into the granular dibasic salt. Again, a hydrochloric acid solution of a very ferruginous Suffolk coprolite was treated with milk of lime until a permanent precipitate formed, then boiled, filtered, and washed thoroughly with boiling water. The washed insoluble precipitate was wholly phosphate of alumina and iron, and did not contain a trace of phosphate of lime. Dr. Morfit's method is based on the principle that when a hydrochloric acid solution, containing phosphates of lime, alumina, and iron, is neutralised with lime, none of the two latter precipitate until all the phosphate of lime has been thrown down; or that, in other words, phosphates of alumina and iron precipitate phosphate of lime. My results do not bear this out. Will Dr. Morfit explain where the error lies?

In testing these precipitates for phosphate of lime, I dissolved in hydrochloric acid, added ammonia until a permanent precipitate formed, then oxalic acid in excess, and oxalate of ammonia.

In his book, Dr. Morfit does not show the benefit which is going to accrue from the use of the pulpy oxides and phosphates of aluminum and iron as precipitants of the phosphate of lime in place of caustic lime. It certainly does not save lime, and there will be the expense labour in obtaining the pulp.

Several plans for economising chloride of calcium are given by the Dr., two of which are novel.

By the application of sulphate of potash to chloride of calcium liquor he obtains precipitated sulphate of lime, and a solution of muriate of potash, the former of which he applies as a drier. It would be interesting for some manufacturer who purchases powdered gypsum at 15s. to 20s. per ton, to calculate what it would cost him to make it by Dr. Morfit's plan.

Mr. Townsend's phosphate of soda is to be transposed by his chloride of calcium into precipitated phosphate of lime and table salt! Will the price and demand for the latter compensate for the soda-ash or caustic soda thus destroyed? To use Dr. Morfit's favourite expression, this would be a "profligate application" indeed.

With regard to the analysis of mineral phosphates and artificial manures, I agree with Dr. Morfit that it is extremely desirable to ascertain what proportion of the phosphoric acid belongs to lime, alumina, and oxide of iron, but the process he gives fails to attain those results. As the individuality of these several phosphates is lost when obtained in the one solution, his method only gives the several proportions of oxide of iron, alumina, phosphates of iron, alumina, and lime, in the form in which they are determined, and not as they existed in the original sample. How he obtains oxide of iron and phosphate of magnesia in an acetic acid solution, and separates the oxide of iron by extract neutralisation with ammonia from the phosphate of magnesia, is a puzzle to me.

The estimation of the ammonia in manures, so important a matter, is done by a defective indirect method, not directly by distillation with lime or soda. After separating phosphates by adding milk of lime as long as a precipitate falls, filtering off, and boiling down the solution to dryness at 212°, then heating the residue to a temperature much short of redness, he notes the loss as chloride of ammonium. No account is taken of soluble organic matter, or a reaction between the ammoniacal salts and nitrates. As no determination of the total nitrogen by combustion with soda-lime is mentioned, any nitrogenous matter—blood, wool, bones—is entirely overlooked.

Reich's method for the estimation of nitric acid, inapplicable for manures, is the one Dr. Morfit recommends, but no effort is made by him to rid the residue of soluble organic matter or ammoniacal salts before igniting with the silicic acid, so that the loss by ignition will represent much more than nitric acid.

Finally, the citric acid method is laid down as a means for estimating the phosphoric acid in phosphates of alumina. Recent investigations have fully proven the superiority of the molybdic process for such determinations.

As Dr. Morfit claims for his work a considerable degree of scientific and practical accuracy, it would be well if the analytical directions were to be generally discussed. There can be no question of the importance of obtaining reliable and useful results in manurial analysis, and it would be desirable that Dr. Morfit should explain why he has chosen to depart from many of the well-known, though possibly effete, processes of chemical analysis.

Miles Platting, Manchester.

VOLUMETRIC ESTIMATION OF SMALL QUANTITIES OF ARSENIC AND ANTIMONY.

By A. HOUZEAU.

There does not exist a method sufficiently sensitive to ensure the exact and rapid quantitative estimation of arsenic and antimony, notwithstanding that even very small doses of these substances act energetically on the human body. I intend to prove that this is a problem that can be solved, and I quote the following results:—

I. The hydrogen compounds of arsenic and antimony are almost entirely and instantaneously absorbed by slightly-acidulated nitrate of silver (Dumas), according to the following formulæ, confirmed by analysis:—

$$6(AgO,NO_5) + AsH_3 = 6NO_4 + 3HO + 6Ag + AsO_3,$$

which gives Ag = 0·11574 As and—

$$3(AgO,NO_5) + SbH_3 = 3NO_4 + 3HO + 3Ag + Sb,$$

which gives Ag = 0·1867 Sb.

II. On this reaction, an accurate and sensitive process for the indirect estimation of arsenic and antimony according to the quantity of silver precipitated can be based, and also a direct process for the estimation of arsenic according to the proportion of arsenious acid formed.

III. *Indirect Process.*—This process is carried on in the following manner:—The substance containing arsenic or antimony, so prepared that it can be reduced by hydrogen, is placed in a Marsh apparatus in which hydrogen is evolved from pure zinc and pure hydrochloric acid. The gas is first conducted through a column of chalk (lumps of chalk put into a tube placed vertically), and next into a titrated solution of neutral nitrate of silver, which is then diluted with its own bulk of water, and acidulated with two or three drops of nitric acid, or, still better, by 0·5 c.c. of acetic acid, so as to prevent the precipitation of a certain quantity of arsenite of silver. The silver which remains in solution is estimated by means of a titrated solution of common salt (Gay-Lussac's process).

IV., V., VI. The estimation of the arsenic may be performed by the direct method, consisting in a chlorometric process with the silver solution which has been used for absorbing the anseniuretted hydrogen. For this purpose the whole of the silver is precipitated by a slight excess of a 3 per cent chloride of sodium solution; the volume of the liquid and precipitate is measured (say 25 or 50 c.c.), and the whole thrown on to a perfectly dry filter, which is not washed. The clear filtered liquid is first measured (say 22 to 40 c.c.), and then poured into a test-glass, and there is added to it 1 or 2 c.c. of perfectly pure and colourless hydrochloric acid. The quantity of arsenious acid is next estimated by means of a titrated solution of permanganate of potassa.

VII. I quote the following results as instances of the accuracy of both the indirect and direct methods—

Indirect Method.—Arsenic and antimony calculated from the loss of silver of the titrated solution—

Arsenic.		Antimony.	
Put in.	Found.	Put in.	Found.
m.g.	m.g.	m.g.	m.g.
3·33	3·36	5·00	4·82
9·99	10·18	10·18	9·88

Direct Method.—Arsenic estimated as arsenious acid by means of a titrated solution of hypochlorite of soda—

Arsenic.	
m.g.	m.g.
9·99	10·40
3·33	3·38

VIII. The methods, simultaneously applied, may be used to estimate with precision a mixture of arsenical and antimonial compounds, and also for the quantitative analysis of arseniuretted hydrogen mixed with antimoniuretted hydrogen. Example—

Total quantity of silver precipitated by the hydrurets of antimony and arsenic, 57·3 m.g.

Silver, precipitated by arseniuretted hydrogen, and calculated from the arsenic estimated as arsenious acid, 29·2 m.g.

Therefore, silver precipitated by antimoniuretted hydrogen, 28·1 = 5·24 m.g. of antimony.

Resumé.

	Put in.	Found.
Arsenic	3·33	3·38
Antimony	5·00	5·24

IX. The method is also applicable to the estimation of arsenic and antimony mixed with organic substances, but it is necessary to first destroy these substances, by means of a method which I shall afterwards explain.

X. Although this method is only directly applicable to those antimonial and arsenical compounds which admit of being reduced by nascent hydrogen, such as arsenic and arsenious acids, antimonic acid, &c., the use of this method may be extended to sulphurets and phosphurets of arsenic, after the previous oxidation of these substances by means of hydrochloric acid and chlorate of potassa.

XI. This process of oxidation will always have to be resorted to when arsenic or antimony are to be detected in a combination of unknown composition, because sulphurous, sulphhydric, phosphuretted hydric compounds will affect the silver solution in the same manner as arseniuretted and antimoniuretted hydrogen.

XII. Pure hydrogen does not, as has been often stated by chemists, reduce the nitrate of silver solution.—*Comptes Rendus*.

COAL-TAR COLOURS.

By E. WALLER, F.M.

I have attempted to collect, though imperfectly, the names of the various coal-tar colours, both commercial and chemical, together with their chemical formulæ, when those could be found. Many of the compounds here mentioned are not now in use as dyes, either because they are too expensive, or because their use is inconvenient, requiring too complicated a treatment or rare chemicals to fix them upon the goods, or because they have been superseded by dyes of better quality. Several colours, black especially, are usually produced on the fibre of the goods by printing them with various salts of aniline and rosaniline, and then with salts of copper, chlorates, &c. Most of the dyes called aniline blacks give, when dissolved, deep green solutions. Of those to which the formulæ are not given, the chemical formulæ are not as yet known, or they have not been given by those works to which I have resorted on the subject. The derivatives of aniline and toluidine are given together, as the two are with difficulty separated from each other, and in course of manufacture the separation is never attempted.

Colours Derived from Aniline or Phenylamine ($C_{12}H_7N$) *and Toluidine or Tolylamine* ($C_{14}H_9N$).

Reds.

Hydrochlorate of Rosaniline, $C_{40}H_{19}N_3,HCl$.
Called also—Aniline red, new red, magenta, solferino, fuchsine, anileine rougé, roseine, and azaline.
Acetate of rosaniline, $C_{40}H_{19}N_3,HO,C_4H_3O_3$.
Known also by the same names as the above.
Nitrate of rosaniline, $C_{40}H_{19}N_3,HO,NO_5$.
Known by the same names as the hydrochlorate; also as rubine and rubine imperial.
Dicodhydrate of trimethylchrysaniline—
$C_{44}H_{14}(C_2H_3)_3N_3,2(HOI)$.
Called also chrysaniline red.
Nitrosophenyline, $C_6H_6N_2O$.

Chemical formula unknown—
Xylidine, tar red, soluble ruby.

Blues and Violets.

These shade into one another so gradually that they cannot well be separated.
Hydrochlorate of monophenylrosaniline—
$C_{4}H_{}(C_{12}H_5)N_3,HCl$.
Called also—Rosaniline violet, red monophenylrosaniline, and Hofmann's violet.
Hydrochlorate of diphenylrosaniline—
$C_{4}H_{}(C_{12}H_5)_2N_3,HCl$.
Also known as rosaniline violet and Hofmann's violet.
Triphenylrosaniline, or triphenyl rosaniline—
$C_{4}H_{}(C_{12}H_5)_3N_3$.
Called also—Aniline blue, rosaniline blue, Hofmann's blue.
Bleu de Paris, bleu de Lyons, bleu de Mulhouse, bleu de Mexique, bleu de nuit, bleu lumière, bleuine, azurine, and night blue.
Hydrochlorate of triphenylrosaniline—
$C_{4}H_{19}(C_{12}H_5)_3N_3,HCl$.
Known also by the same names as the above.
Acetate of triphenylrosaniline—
$C_{40}H_{19}(C_{12}H_5)_3N_3,HO,C_4H_3O_3$.
Known also by the same names as the above.
Bisulphotriphenylrosaniline acid—
$C_{4}H_{19}(C_{12}H_5)_3N_3,4SO_3$.
Called also Nicholson's blue and soluble blue.
Hydrochlorate of monethylrosaniline—
$C_{40}H_{}(C_{12}H_5)N_3,HCl$.
Called also Hofmann's red violet.
Hydriodate of ethylrosaniline, $C_{40}H_{18}(C_4H_5)N_3,HI$.
Called also Hofmann's red violet.
Ethyliodate of ethylrosaniline, $C_{40}H_{18}(C_4H_5)N_3\,C_4H_5I$.
Called also fuchsine with a blue tint, and Hofmann's violet red.
Hydrochlorate of diethylrosaniline—
$C_{4}H_{17}(C_4H_5)_2N_3,HCl$.
Called also Hofmann's blue.
Ethyliodate of diethylrosaniline—
$C_{4}H_{17}(C_4H_5)_2N_3,C_4H_5I$.
Called also Hofmann's red violet and ethylic rosaniline violet.
Hydrochlorate of triethylrosaniline—
$C_{40}H_{16}(C_4H_5)_3N_3,HCl$.
Called also Hofmann's blue.
Ethyliodate of triethylrosaniline—
$C_{40}H_{16}(C_4H_5)_3N_3,C_4H_5I$.
Called also Hofmann's blue and ethylic rosaniline violet.
Ethylbromate of triethylrosaniline—
$C_{40}H_{16}(C_4H_5)_3N_3,C_4H_5Br$.
Called also brimula.
Hydrochlorate of methylrosaniline—
$C_{40}H_{18}(C_2H_3)N_3,HCl$.
Hydriodate of methylrosaniline, $C_{40}H_{18}(C_2H_3)N_3,HI$.
Hydrochlorate of dimethylrosaniline—
$C_{40}H_{17}(C_2H_3)_2N_3,HCl$.
Hydrochlorate of trimethylrosaniline—
$C_{4}H_{17}(C_2H_3)_3N_3,HCl$.
Methylaniline, $C_{12}H_5(C_2H_3)N$.
Called also methylic rosaniline violet and violet de Paris.
Mauvaniline, $C_{38}H_{17}N_3$.
Voilanile, $C_{36}H_{15}N_3$.
Mauveine, $C_{54}H_{24}N_4$.
Called also—Mauve, aniline purple, Perkin's violet, indisine, analeine harmaline, violine, and mauve rosolane.
Hydrochlorate of mauveine, $C_{54}H_{24}N_4,HCl$.
Known also by the same names as mauveine.
Hydrochlorate of ethylmauveine, $C_{54}H_{23}(C_4H_5)N_4,HCl$.
Called also dahlia.
Ditolylrosaniline, $C_{40}H_{17}(C_{14}H_7)_2N_3$.
Called also toluidine blue.
Tritolylrosaniline, $C_{4}H_{16}(C_{14}H_7)_3N_3$.

Chemical formulæ unknown—
Regina blue, opal blue, regina purple, bleu de Fayolle, violet de Mulhouse, Britannia violet, geranosine, violet imperial.

Greens.

———— $C_{40}H_{13}(C_4H_5)N_3,2HO$.
Known as—Aldehyde green, aniline green, viridine, and emeraldine.
———— $C_{4}H_{13}(C_2H_3)_6N_3,2HO$.
Known as iodine green and iodide of methyl green.

Chemical formulæ unknown—
Iodide of ethyl green, Perkin's green.

Yellows.

Chrysaniline, $C_{40}H_{17}N_3$.
Called also Phosphine, aniline yellow, and Yow fuchsine.
Nitrophenylbiamine, $C_4H_6O_4,HCl$.

Chrysotoluidine, $C_{42}H_{20}N_3$.
Zinaline. $C_{40}H_{19}N_3O_4$(?).

Chemical formulæ unknown—
Dinitroaniline, Field's orange(?).

Browns.

Chemical formulæ unknown.
Havanna brown, Bismark brown, aniline brown, aniline maroon, Napoleon brown.

Greys.

Chemical formulæ unknown—
Aniline grey, argentine.

Black.

Chemical formulæ unknown—
Aniline black.

Colours Derived from Naphthaline or Naphthylhydrate ($C_{20}H_8$).

Reds.

Chloroxynaphthylic acid, $C_{20}H_5ClO_6$.
Called also—Pseudoalizarine, naphthylic red, and chloronaphthaline acid.

Chemical formulæ unknown—
Roseonaphthaline, carminaphtha.

Yellows.

Binitronaphthaline, $C_{20}H_6(NO_4)_2$.
Called also—Binitronaphthal, naphthalamine yellow, Naphthylic yellow, golden yellow, and Manchester yellow.
Binitronaphthylic acid, $C_{20}H_5(NO_4)_2O,HO$.
Known also by the same names as the above.
Trinitronaphthylic acid, $C_{20}H_4(NO_4)_3O,HO$.

Colours Derived from Carbolic Acid, and Phenic Acid, Phenylhydrate or Phenol ($C_{12}H_6O_2$).

Reds.

Picramic acid, $C_{12}H_5(NO_4)_2NO_2$.
Called also picramine acid.
Coralline, $C_{20}H_8O_4$.
Called also peonine.
Coralline amide, $C_{20}H_9NO_2$.
Called also red coralline.

Blue.

Isopurpuric acid, $C_{12}H_3(NO_4)_2NO_3,2Cl$.
Called also bicyanide of picramyl and Grénat.

Green.

Chemical formulæ unknown—
Chloropicrine.

Yellows.

Picric acid, $C_{12}H_2(NO_4)_3O,HO$.
Called also trinitrophenic acid and carbazotic acid.
Aurine, $C_{24}H_{12}O_6$.
Called also rosolic acid.

Browns.

Picrate of ammonia, $NH_4O,C_{12}H_2(NO_4)_2O$.
Isopurpurate of potash.

Chemical formulæ unknown.
Phenyl brown, or rotheine, or phenicienne.
Azuline (blue), $C_{24}H_{11}NO_4$, and another viridine (formula unknown) are both an aniline and a carbolic acid colour, being produced by the action of carbolic acid on a derivative of aniline.
Cyanine (blue), $C_{60}H_{33}N_2I$, is described in some works among the coal-tar colours, but is derived from chinchonine.

Among the blues and violets, the names Hofmann's blue or Hofmann's violet are seen frequently to occur. These are distinguished in commerce by suffixing the letters B or R the number of times that either is repeated, showing the relative blueness or redness of the dye. They range from BBBB to RRRR. The reddish shades are those in which the least substitution has taken place, as in the monethyl- or monophenyl-rosaniline, &c., while the bluest of these are those which are triethyl, triphenyl-rosanilines, &c. The series of names given for triphenyl-rosaniline and the hydrochlorate of the same base are frequently interchanged. On the ethyliodates and ethylbromates, authorities appear to differ as to whether they really are ethyliodates, &c., or not. The colours are prepared by the action of iodide of ethyl, &c., upon rosaniline or some of its salts and iodine is given off in the operation, but whether one equivalent of the iodide of ethyl remains behind or not in a state of chemical combination does not appear to be fully established. Were the latter supposition the case, the C_4H_5I of those formulæ would be replaced by 2HO, and the chemical name would necessarily be changed to correspond. The same question might be raised regarding some of the Hofmann violets with their equivalent of HCl or $HO,C_4H_3O_3$, but as one of these acids is used in the solution when purifying the colour, the probabilities are that the base unites with it, and the colour goes to market as a salt and not as an isolated base. The terms, direct blues and purified blues,* are simply commercial terms indicating the amount of purification which the dyes have received, the first-named being the most impure. Among the greens the terms aniline green and emeraldine are synonymous terms applied to a colour formed in the fibre of the goods. Viridine is a name applied to a true green, but the term has also been used for a mixture of indigo and picric acid, which cannot properly be called an aniline colour.—*American Chemist.*

ON THE COMPOSITION OF THE LYES WHICH ARE OBTAINED BY THE OXIDATION AND LIXIVIATION OF SODA WASTE FOR THE RECOVERY OF SULPHUR.†

By C. STAHLSCHMIDT.

(Concluded from p. 67.)

Determination of the Sulphurous, Hyposulphurous, and Sulphuric Acids.—Generally the sulphurous and hyposulphurous acids are determined together, by adding to the lye a neutral solution of zinc sulphate or chloride, filtering and washing the zinc sulphide and sulphur, and estimating the acids in the filtrate by a standard solution of iodine. This method, however, has its disadvantages, for the mucous zinc sulphide is difficult to wash, and the quantity of acids is found too high, if the dissolved sulphuretted hydrogen is not driven off by warming before filtering. The method becomes easier and more convenient by substituting neutral manganese chloride for the zinc salt, because the manganese sulphide is washed more readily and completely. It is best to decompose the lye by carbonic acid, which is passed through it until all sulphuretted hydrogen is driven off; calcium carbonate and sulphur are precipitated, from which the liquid is readily filtered. The filtrate is then heated in order to precipitate the calcium carbonate dissolved in the free carbonic acid and then titred directly with solution of iodine. Experiments according to this method gave exactly the same results as those with solutions of zinc or manganese. In all instances the sulphite is converted into hyposulphite by the nascent sulphuretted hydrogen; therefore the quantity of iodine solution must be calculated for this acid. 25 c.c. lye on the average required 76·4 c.c. standard solution of iodine.

25 c.c. lye were precipitated with absolute alcohol, the precipitate filtered and washed first with alcohol and then with water in order to re-dissolve any precipitated hypo-

* See Reimann's "Handbook of Anilines," edited by W. Crookes, p. 126.

† Translated by M. Alsberg, Ph.D. From *Dingler's Polytech. Journal*, vol. 205, No. 3.

sulphites of sodium and calcium (the latter formed by decomposition). The remaining calcium sulphite together with the filter was brought into a beaker and titred with solution of iodine. 45·85 c.c. solution of iodine were used, corresponding to about 0·0032 grm. sulphurous acid. At the first titreing the sulphurous acid was present as hyposulphurous acid, therefore required only half the iodine solution = 22·9 c.c.; the hyposulphurous acid consequently required 7·64 – 22·9 c.c. = 53·5 c.c. = 0·0096 hyposulphurous acid. 25 c.c. lye contain therefore:—

45·85 × 0·0032 = 0·1467 sulphurous acid, and

53·5 × 0·0096 = 0·5136 hyposulphurous acid.

0·1467 sulphurous acid correspond to 0·275 calcium sulphite with 0·0733 sulphur, and 0·0917 calcium 0·5136 hyposulphurous acid give 0·8453 sodium hyposulphite with 0·3424 sulphur, and 0·2461 sodium.

25 c.c. lye gave 0·057 barium sulphate, corresponding to 0·033 calcium sulphate, with 0·008 sulphur and 0·01 calcium.

Determination of the Total Lime.—25 c.c. lye were mixed with an excess of ammonia, and the lime precipitated by ammonium oxalate. After well known manipulations 1·247 grms. calcium carbonate were obtained, corresponding to 0·499 grms. of calcium.

Determination of the Total Soda.—25 c.c. lye were boiled with hydrochloric acid until the precipitated sulphur had conglomerated, filtered, the lime precipitated by ammonia and ammonium oxalate, and the sodium in the filtrate weighed as chloride. Result—1·032 grms. sodium chloride, corresponding to 0·405 grm. sodium.

Determination of the Total Sulphur in 25 c.c. Lye.—5 c.c. lye were mixed with little water, and then powdered copper chloride was added; after the addition of fuming nitric acid heat was applied. The undissolved sulphur weighed 0·175 grm.; the sulphur in the form of barium sulphate 0·0756 grm.—together 0·2506 grm. sulphur. 25 c.c. lye contain, therefore, 1·253 grm. sulphur.

Determination of the Sulphydrate.—The sulphuretted hydrogen liberated from the sulphydrate in the lye by solution of iodine was estimated with a standard solution of potassa according to Mond's method. 25 c.c. lye required 43·75 c.c. potassa solution corresponding to about 0·00321 sulphuretted hydrogen. For the liberated molecule of sulphuretted hydrogen this amounted to 0·14 sulphuretted hydrogen, and for the total sulphur of the sulphydrates, therefore, 0·263 sulphur. If from the 0·405 sodium the sodium contained in the hyposulphite = 0·1461 is deducted, there remains 0·1589 sodium as sulphydrate; this weighs 0·3869 grm., with 0·1174 sulphuretted hydrogen. This quantity deducted from 0·14 grm., which were found, leaves 0·0226 grm. sulphuretted hydrogen for calcinm sulphydrate; these give 0·0704 grm. calcium sulphydrate with 0·0266 grm. calcium.

Determination of the Polysulphurets.—If, from the total quantity of sulphur, = 1·253 grms., there is deducted the sulphur of the sulphurous hyposulphurous and sulphuric acids, and of the sulphydrates, *i.e.*, 0·6867 grm., there remain 0·5663 grm. S; if the calcium of the calcium sulphite, sulphate, and sulphydrate is deducted from the total quantity of sulphur found, there remain 0·3707 grm. Ca, which are combined with the above 0·5663 sulphur to polysulphurets.

I have made the remark, that, bisulphide of carbon will take up sulphur from the lye. This observation, as well as that, that during the oxidation of the soda waste in the air sulphur is separated, proves, that besides the tetrasulphuret the lye must contain pentasulphuret and free sulphur. The two values for sodium and sulphur correspond to 1 mol. calcium, and 1·9 mol. sulphur, which might lead to the assumption of the compound CaS_2 in the lye. The presence of large quantities of tetrasulphuret in the lye, as well as the quantity of sulphur which is precipitated by carbonic acid, entirely contradict this view, not taking into account that Schöne has proved the non-existence of these compounds in solution. Again, it is not possible to assume the whole of the calcium as $4CaO.CaS_4 + 18aq.$, because in this case too large a quantity, ¼ of the total sulphur, ought to be present as free dissolved sulphur.

If we try to combine calcium and sulphur to tetra- and penta-sulphuret, the proportion representing the formula $CaS_5 + 4CaO.CaS_4 + 18aq.$, agrees best. According to this view 5 parts of calcium require 6 parts of sulphur; therefore 0·3707 calcium, 0·445 sulphur. The remainder of the sulphur 0·5663—0·445 = 0·1213 grm. is then dissolved as such. Therefore, 25 c.c. lye contain 0·309 CaS_5 with 0·0618 calcium, and 0·246 sulphur, 1·106 – $(4CaO.CaS_4) + 18aq.$ with 0·309 Ca and 0·198 S.

By passing carbonic acid through the lye, only these two last compounds are decomposed with the separation of sulphur; the former yields ⅘, the latter ¾ of its sulphur together, therefore 0·246. 0·8 + 0198.0·75 = 0·3453 S, to which must be added 0·1213 free sulphur, 0·4666 grm. altogether. The direct experiment gave 0·468 and 0·472, mean 0·470 grm. S, which quantity almost completely corresponds with the one calculated.

The investigation, furthermore, proves that carbonic acid must precipitate all the lime as carbonate, for the sodium sulphydrate, converted into carbonate, is present in sufficient quantity to completely precipitate the calcium sulphite. After decomposition by carbonic acid, boiling, and filtering, the lye contained no more lime.

If we review the results of the analyses, we find that 25 c.c. of the examined lye contained:—

CaS_5,	0·309	grm.
$4CaO.CaS_4 + 18aq.$,	1·106	,,
$CaSO_4$,	0·0333	,,
$CaSO_3$,	0·275	,,
$Na_2S_2O_3$,	0·8453	,,
CaH_2S_2,	0·0704	,,
NaHS,	0·3869	,,
S,	0·1213	,,

Behaviour of the Lye towards Sulphurous Acid.—Schaffner decomposes the lye by hydrochloric acid and passes the sulphurous acid, which appears after the sulphuretted hydrogen, into fresh lye, thereby converting the sulphurets into hyposulphites with the separation of sulphur; the hyposulphites are again decomposed by hydrochloric acid, sulphur being precipitated and sulphurous acid evolved. The sulphur resulting from this process contains considerable quantities of calcium sulphate, whose formation, according to Schaffner, is due to the sulphuric acid of the crude hydrochloric acid, whilst Mond, as has been mentioned, explains it by the formation of trithionic acid, which is formed during the decomposition, and later at an elevated temperature, is split into sulphuric and sulphurous acids and sulphur. The latter theory alone is correct, for the conditions of the formation of trithionic acid are existing under the given relations. Of course the calcium sulphate formed in this manner is increased by that from the sulphuric acid of the crude muriatic acid.

If pure washed sulphurous acid is passed through the sulphur lye, it is completely decomposed, considerable quantities of sulphuretted hydrogen being evolved and a yellow precipitate being formed, the temperature rising at the same time. In this case the action of the sulphurous acid was continued until lead paper was no longer coloured, the liquid had a neutral reaction, and did not, therefore, contain an excess of sulphurous acid. At this stage it contained calcium and sodium hyposulphite, and was completely free from sulphites. The filtered yellow precipitate was pure sulphur, free from calcium hydrate or sulphite, burning on platinum foil without leaving a residue. Consequently the decomposition does not take place in such a manner that difficultly soluble calcium sulphite is precipitated; but the sulphurous acid acts exactly like the carbonic or hydrochloric acid, it decomposes each single compound, sulphur and sulphuretted hydrogen being separated and combining with the bases,

it is instantly converted into hyposulphurous acid by the nascent sulphuretted hydrogen. This process, practised by Schaffner long since, is especially adapted to the manufacture of sodium hyposulphite; the lye, which has been treated with sulphurous acid until neutral, is decomposed either with sal-soda or soda ash; calcium sulphate or carbonate is precipitated, and there remains a concentrated solution of hyposulphite of soda, which after evaporation gives the salt almost pure. For lyes, which like the one examined can be completely purified from lime by carbonic acid, this process may be employed; but part of the sodium is then converted into carbonate. In this case, the sulphur being mixed with large quantities of carbonate of lime, might, perhaps, not be easily recovered.

If the lye, which has been neutralised with sulphurous acid and filtered, is again subjected to the action of sulphurous acid, no sulphur is precipitated, thus affording proof that the sodium hyposulphite is not decomposed; but if the liquid is heated on the water-bath, very soon a precipitate of sulphate of lime and sulphur is formed. In order to further elucidate this behaviour, a solution of pure calcium hyposulphite was heated, whereby according to the statements made hitherto, the salt ought to be split into calcium sulphite and sulphur. I have convinced myself, that even after protracted boiling this reaction is only a subordinate one, that, on the contrary, the salt is chiefly decomposed according to the formula $CaS_2O_3 + H_2O = CaSO_4 + SH_2$, calcium sulphate being formed and sulphuretted hydrogen evolved slowly but steadily.

If sulphurous acid is added to the solution of hyposulphite of lime and the whole heated on the water-bath, the liquid is coloured yellow, and after concentration suddenly a heavy precipitate of sulphate of lime appears, whose quantity cannot be compared with that formed without the addition of sulphurous acid. I was tempted to the belief that this decomposition takes place in this manner, because the sulphurous acid commences the process; this, however, is not the case, for if little sulphurous acid is added to the hyposulphite of lime, very little sulphur is precipitated, and the liquid contains sulphuric acid, but even after heating it on the water-bath for some length of time, no sulphate of lime is precipitated; only soon after adding an excess of sulphurous acid a heavy precipitate of sulphate of lime is formed. In the presence of sulphurous acid the decomposition of the hyposulphite of lime takes place in a different manner from that without it; the conditions for the formation of trithionic acid being given, first calcium trithionate is formed, which, on heating, is decomposed into sulphate of lime, sulphurous acid, and sulphur.

If the calcium hyposulphite is mixed with a little hydrochloric acid and heated, a precipitate of sulphur and sulphate of lime is formed; also in this case the sulphurous acid from the hyposulphurous acid has formed trithionic acid, which then was decomposed with the formation of sulphuric acid. If the quantity of hydrochloric acid necessary for the complete decomposition is added at once, no calcium sulphate is formed. The sodium salt behaves like the calcium salt; according to the quantity of hydrochloric acid it gives, when heated, sulphuric acid or not; in the latter case with an excess of hydrochloric acid the hyposulphurous acid being decomposed into sulphur and sulphurous acid.

The behaviour of the hyposulphurous acid in the sulphur lyes towards sulphurous acid is the same as that of the pure solutions of hyposulphurous acid, no matter whether the sulphurous acid be directly added or formed in the lye: the latter is always the case when the lye is decomposed by muriatic acid.

If the sulphur lye is heated to 60° C. and carefully mixed with hydrochloric acid, sulphur is separated and sulphuretted hydrogen evolved, but the sulphur re-dissolves, as I have already remarked. After a further addition of hydrochloric acid sulphur is precipitated, the lye is discoloured, and towards the last gives off sulphurous acid. This proves, that also here first the sulphurets and sulphhydrates are decomposed, and only later the sulphites and hyposulphites with the evolution of sulphurous acid. If the volume of the decomposed lye, which contains a certain quantity of free sulphurous acid, is just sufficient to convert into hyposulphites all the sulphurets and sulphydrates of the fresh lye which has been added, the process has been conducted faultlessly, *i.e.*, the smallest quantity of sulphate of lime is formed. If, on the contrary, the process of decomposing the lye is executed in such a way as to leave free sulphurous acid after the formation of those compounds, trithionate is instantly formed, which soon afterwards gives, by decomposition, sulphate, in our case calcium sulphate.

In Schaffner's process, where after decomposing the lyes by muriatic acid the free sulphurous acid is passed into fresh lye, a large quantity of sulphate of lime is formed, which seems to indicate that the quantity of sulphurous acid is too large. The reason, I think, is that the oxidised waste is very rich in hyposulphites, and that, therefore, by the decomposition of the lyes with muriatic acid too much sulphurous acid is liberated.

I am not able to precisely state how to operate on a large scale, for, as has been proved by others, the composition of the lyes is subject to great fluctuations; but the trithionates play an important part, as stated by Mond, and it is advisable to conduct the decomposition of the lyes by muriatic acid and the action of the sulphurous acid, or that of the decomposed lye on fresh lye, in such a manner as to exclude the formation of trithionates.—*American Chemist.*

PYROLOGY, OR FIRE ANALYSIS.*

By Captain W. A. ROSS, R.A.

(Continued from p. 70).

Fish-tail Flames.

25. If a pyrochromatic substance be held on the loop of a platinum-wire in a rapid hydrocarbonous current, produced by blowing strongly, the current is broken upon it so as to form a kind of fish-tail flame at its rear, *i. e.*, the side turned *from* the base of the pyrocone, in the blue matter of which its front is enveloped as usual. The inner sides of this fish-tail flame will, after a short time, be observed to be deeply and continuously tinged with the colour which is the chief characteristic of the substance burned.† A far stronger pyrochromatic reaction is thus obtained than by holding the substance in the position usually adopted, of what is called "the point of the outer flame," or, in fact, in an oxyhydrogen pyrocone; for here the superposed blast is too violent, and carries away the colour as soon as formed.

The Oxyhydrogen Pyrocone. (O. P.)

26. In which the object is held as at *a*, Fig. 1. It is commonly called "the oxidating, oxidising, or outer flame;" but that the two first of these appellations are incorrect is shown by the fact that when some metallic oxides, as those of gold, silver, or mercury, dissolved in a flux more delicately sensible to oxidation and reduction than borax or microcosmic salt, viz., phosphoric acid, are held in this position, the bead, so far from being further oxidised, immediately precipitates its contents, and becomes dim or opaque in consequence.

27. This pyrocone appears to be caused by the intermingling of the two currents—of air and ignited hydrocarbonous matter, its broadest part being at *a*, where they may be supposed to cross each other, giving it a slightly oblate appearance.

* Communicated by the Author. From the *Proceedings of the Royal Society.*

† The substance should occasionally be dipped in distilled water.

The Peroxidising Pyrocone. (P. P.)

28. In order to produce the full effect of this pyrocone, the object must be held at a distance of 3 inches from the point of the blue. It can be produced, but not long sustained, by the mouth, as a very strong blast is necessary to impart sufficient heat to an object at such a distance (3, Fig. 1).

The Bunsen Blowpipe.

29. Before leaving the subject of pyrocones, it is necessary to mention that the ingenious blowpipe of Bunsen, by which the breath is *forced* into a jet of ignited gas itself, is utterly useless for the purposes, and to produce the results detailed in these pages. The pyrocone thus formed is indeed the counterpart of that produced by blowing into the pyrocone of a spirit-lamp, except that its temperature is perhaps higher, with the deleterious results mentioned in paragraph 12.

The Fluxes.

30. These are invariably supported on platinum-wire in the admirable and perfect manner invented by Gahn, and, as soon as a pyrocone is applied, assume the form of a spheroidal bead, which revolves or spins round upon its centre with a rapidity proportional to the fluidity of the matter of which it is composed. The "glasses" or "beads" thus formed, with the oxides dissolved in them, may be quantitatively determined, as to their weight and size, by means to be presently described.

31. Berzelius informs us that "Cronstedt used but three reagents—basic carbonate of soda, borate of soda, and the double salt of phosphate of soda and ammonia. These reagents are still in use; and among the great number of those which have been tried since that time, not one has been found to replace either of these. It is singular enough that, in the very beginning of the art, the very best reagents should have been hit upon." ("Berzelius on the Blowpipe," p. 32).

32. One of the objects of this paper is to attempt to show that the two last fluxes mentioned in the above paragraph are not only *not* "the very best reagents," but that they have, by the complicated and obscure results obtained necessarily from their compound nature, seriously retarded the progress of pyrognostic examination. For instance, speaking of the third flux mentioned, the metaphosphate of soda, produced from what is commonly called microcosmic salt, Berzelius says (p. 39),—"Its efficiency as a reagent depends principally on its free phosphoric acid; and it is preferred to this because the phosphoric acid cannot be kept without deliquescing, while at the same time it is much dearer, and is also easily absorbed by the charcoal. The salt of phosphorus shows, therefore, the action of an acid upon the substance to be tested."

Phosphoric Acid (Symbol P).

33. Now, if glacial phosphoric acid be heated until it melts into a substance of viscid or gum-like appearance, and be thus poured hot into a wide-mouthed stoppered bottle (which should also be hot when receiving it), it can not only be kept without deliquescing, but, when solidified by cooling in the bottle, may be carried about in the pocket without fear, kept for years in the most rainy climate, and allowed to remain, even for hours, with the stopper of the bottle off. It has also the great advantage of being now-a-days far more easily procured pure enough for the purpose from most respectable chemists, even in out-of-the-way stations, as in India, in consequence of its use in therapeutics, than microcosmic salt can be. It is used by simply dipping the red-hot platinum-wire loop and the glass, of whatever description, formed upon it into the bottle, when a fresh supply of phosphoric acid adheres to the hot bead, without the supply in the bottle being at all adulterated.

34. That the metaphosphate of soda does *not*, when heated, exert upon substances added to it the reactions of an acid, unless the basic soda be displaced by another base for which the acid possesses a greater attraction, must be evident to an ordinary chemist; and there would appear to be few substances for which phosphoric acid has a greater attraction than it has for soda; in fact, the most valuable pyrognostic reactions *prima facie* of the acid upon substances have been lost to operators precisely because the salt it forms with soda *fails* to give us those acid reactions, as follows:—The acid effervesces violently with all carbonates, and with some of the metallic oxides,—the salt does nothing of the sort; and the necessity felt by many mineralogists and geologists of carrying about in their pockets a phial of the unpleasant and dangerous hydrochloric or nitric acid is thus at once obviated.

35. The *acid* used to dissolve cobalt oxide in any considerable proportion is blue-hot, but assumes on cooling a magnificent red-violet colour,* to which the modern word "magenta" is partly applicable. When soda or potash is applied to this glass in sufficient proportion (about 17 per cent) to form the metaphosphate of those bases, the glass remains blue, and a standard of alkali for purposes of calculation is thus evidently obtained. But as cobalt oxide produces with this flux many shades of colour, according to the quantity in which it is added, from a pale and scarcely perceptible pink to the deep crimson-violet above mentioned, and as these degrees of red are exactly azurised † by a corresponding strength or quantity of the alkali added, it is plain that a kind of chromatic scale or table of colours might thus be made of great use in the quantitative measurement of alkalies on the one hand, or of cobalt oxide on the other, instead of the unvarying "blue" which we find opposite oxide of cobalt in all blowpipe tables.

36. Instead, therefore, of superfluously multiplying illustrations of the difference between the reactions of the pure acid used as a flux and of the assumed "free acid" in microcosmic salt, it will be better to give here in slight detail some of the more important of the former with various oxides.

Gold.

37. Is dissolved and oxidised by this flux in an O. P. (as at *a*, Fig. 1), when added in minute portions of the leaf,—a fact which suggests that P under these conditions is more powerful as a solvent than any one of the mineral acids. As stated in paragraph 26, the position (*a*, Fig. 1) will precipitate the dissolved gold oxide, rendering the bead of a dirty or muddy appearance, which the application of a P. P. (as at 3, fig. 1) will soon remove, the bead then appearing not merely diaphanous, but highly refractive. If this brilliant auriferous glass be now treated with a good H. P., the white metallic-looking film referred to in par. 15 is formed, with a slight but distinct shade of yellow-like pinchbeck, which is apparently due to the gold in solution; and this bead may thus be made alternately diaphanous and metallic-looking as often as is desired.

38. If the auriferous transparent bead be carefully kept for some time about ½ an inch from the point of the whole pyrocone, or 2 inches from the blue, as at 2, Fig. 1, a beautiful shade of bluish-rose-colour flushes over it just as it is becoming cold;‡ and the production of this tint, which cannot be confounded by the dullest observer with the red-violet of cobalt, or the amethyst tinge of titanic acid or manganese, is an excellent test of the skill of the operator, as well as of the delicacy of the pyroconical reactions in this flux, for a hair's breadth too far towards 3, Fig. 1, will cause the glass to be diaphanous and colourless on cooling; while a corresponding error in the other direction towards 1 will, as has been mentioned, produce a muddy appearance.

39. Gold-leaf is more rapidly dissolved, and the above reactions more easily produced in a glass of *phosphate of lime*, which appears to be, under pyrological conditions, a

* Discovered by the writer on July 12th, 1869.

† Lithia and its salts will not apparently azurise this cobaltine glass, but afford with it a very pretty purple-violet colour.

‡ The addition of fresh phosphoric acid at this stage brings out this beautiful reaction still more decidedly.

more powerful solvent of metallic oxides than any other known flux. It will be afterwards described; but it has the disadvantage in analysis, referred to in par. 32, of being a salt.

40. The ruby colour bestowed by gold upon glass and fluxes would thus appear, by the experiment above detailed, to be due to an *exact* amount of oxidation. The oxides of tin and and antimony, added with it to colour-glass under the name of "purple of Cassius," &c., seem not to have anything to do with the production of the colour.†

Silver.

41. The most infinitesimal trace of the oxide, or of a salt of silver, added to a bead of P, gives a copious yellow precipitate like cream, accompanied at *first*, if the bead be held in a P. P., as at 2 or 3, Fig. 1, by a very beautiful but very transient rose-colour. This is such a delicate reaction for silver that it will be at once obtained from most galenas; and although thus a most important test *qualitatively*, is too fine to admit of being used as a quantitative standard for the estimation of rich ores.

42. There are two ways of effecting this. First, for an ore supposed to contain only a small percentage of silver. If the slightly argentiferous glass be retained in the position 3, Fig. 1, the yellow precipitate soon disappears, and the glass becomes clear, highly refractive, and brilliant. On changing its position in the pyrocone to that of *a*, Fig. 1, at present called the "oxidising flame," the yellow precipitate immediately and copiously reappears; but there is no visible mark or signification by which the operator can thus judge of the quantity of silver oxide added. When, however, this amounts to 5 per cent of the whole glass, and the latter, rendered diaphanous by the first position, is suddenly and momentarily brought into the second one indicated above, or, better, to just the tip of the blue, from whence, however, it must be instantaneously removed, a very remarkable and very beautiful appearance results. It is that of an almost perfect imitation of a pearl, produced apparently by the reduction of the oxide *near* the surface to the metallic state, while a vitreous glaze or gloss is still retained *upon* the surface.

43. This, then, may be called the first standard of silver for ores containing that oxide up to 5 per cent, though of course it may be used for richer ones; but the following method is more rapid for a rich ore, provided there are no chromatic oxides present to interfere with the clearness of the glass.

44. Second, for rich argentiferous ores. If we continue adding oxide of silver to a weighed P glass, and dissolving it carefully as at 3, Fig. 1, we shall find the glass remains diaphanous until 20 per cent of the oxide has been added, when the yellow creamy precipitate again begins to appear, causing, for rich ores, 20 to be the standard of silver. Of course, in calculating results from these "standards," the ratio deducible from them must be of the *inverse* kind; that is, for instance, if we find an argentiferous ore requires to be added to the extent of 40 per cent in order to produce the yellow precipitate in a P. P., as at 3, Fig. 1, or just double the quantity of the pure oxide of silver to effect the same result, we take the proportion of Ag as just half of purity, or 50 per cent.

Mercury and the Volatilisable Metals in P.

45. If these oxides are taken upon the hot glass, and the mass inserted into a good H. P., as in Fig. 4, they are neither volatilised nor dissolved. The volatile oxides under such conditions form part of the metallic-looking crust or film, which is invariably formed over the surface, and can thus be added in large quantity with a very trifling loss. If the mass be now treated with a P. P., as at 3, fig. 1, these oxides are rapidly dissolved, all of them bestowing on the P glass a brilliant golden-yellow, especially arsenic acid, by which a glass is thus produced quite equalling in appearance the finest topaz.

46. If this glass be now returned to an O. P., as at *a*, Fig. 1, the oxide is immediately precipitated with a dim, and often an opaque grey or grey-black, appearance; and although mercuric oxide (for instance) is usually presumed to be of so volatile a nature that its reactions are not given in blowpipe tables, this mercurial oxide is so difficult to volatilise that the strongest O. P. will not clear the P bead from it, but only burn both slowly away.

Sulphur.

47. If sulphur be added to a P bead, as described in par. 45, and then treated with a P. P., the curious result of chromatic reactions exactly similar to those of copper, *i. e.*, green hot and blue cold, is produced. The addition of plumbic oxide heightens this effect; and the resulting blue bead is quite indistinguishable from a cupreous one placed alongside.

Nitrogen.

48. If a P bead be constantly dipped in the strongest possible solution of ammonia or in concentrated nitric acid, and immersed as often in a H. P., as Fig. 4, numerous black specks will be found on the surface like carbon, but much more difficultly burned away After a time these appear to combine with the metallic-looking film which is formed by the H. P., and the substance is then by no means easily volatilised. The glass thus impregnated with nitrogen will be found to be clear hot, yellow and gelatinous on cooling, therein exactly differing from those of the alkalies, the volatilisable oxides, and some of the earths, which are yellow hot and clear cold.

Oxide of Copper in P.

49. If we add pure cupric oxide to a weighed P bead, and treat it with a P. P. (2, Fig. 1), we find that it takes exactly 5 per cent of the whole bead to produce distinctly the peculiar *blue* of copper. The glass must be carefully held in the position indicated, as O. P. would leave it *green*:* 5 per cent, then, may be taken to represent the standard of copper for quantitative measurements, as described in par. 44; but in such cases as Cu pyrites, where there is a chromatic interference of other oxides, something more is necessary.

50. It requires one-third more than the weight of a P glass in sulphur to give it the cupreous blue appearance referred to in par. 47; that is to say, a 50 mgrs. glass of P requires 75 mgrs. of flour sulphur added by degrees for that purpose. But it is found that by treatment in H. P. the flour sulphur, when it assumes the metallic appearance referred to in par. 17, is reduced to one-fifth of its bulk; so that 75 mgrs. of flour sulphur only represent 15 mgrs. of the allotropic sulphur, and 15 therefore is taken as the standard of sulphur. It has also been ascertained that 16 mgrs. per cent of oxide of copper, when added to this sulphurous P bead, cause it to remain *green* even after a P. P., probably on account of the disposal by the sulphur of the superfluous oxygen; 16, therefore, is taken as the equivalent standard of copper to sulphur. If we now add oxide of lead to the *green* cupreo-sulphurous P bead thus produced, we shall find that, on the addition of 24 mgrs. per cent, the glass will again appear blue; 24, therefore, is taken as the equivalent standard of PbO to sulphur.

51. Copper pyrites dissolved in a P glass has a dirty green appearance, without any shade of blue in it, after a P. P. As an example, it took 57·1 mgrs. of PbO to azurise a green Cu pyrites P bead of 100 mgrs.

PbO S Per cent.
Then 24 : 15 :: 57·1 = 35·6 sulphur.
Cu
24 : 16 :: 57·1 = 38·0 copper.
Therefore the oxide of iron = 26·4 iron.

This is not very wide of the actual composition of Cu pyrites as decided by chemical analysis,—which is sul-

† No metal, not even gold, has any tendency to alloy the platinum-wire in this flux when kept under a P. P. [Phosphofluate of lime gives with gold oxide a bead as blue and brilliant as a sapphire.—September 14th, 1872.]

* This is not the case with borax or microcosmic salt.

phur, 34·9; copper, 34·6; iron, 30·5. The specimen treated was a rich one from Freiberg, in Saxony.*

52. With rich ores, as the red oxide, the method (par. 49) is so delicate, that an assay roasted *through* platinum foil gave 4 mgrs. more in the hundred than it did unroasted. The best and safest plan is to have an azure P glass coloured with 5 per cent of CuO as a pattern, and place the assay alongside of it on a sheet of white paper.*

Titanium and Tin in P.

53. A diaphanous P glass having either of these oxides dissolved in it will, after being held a considerable time, as at 3, Fig. 1, show (apparently) crystals, yellow with Ti, and white with Sn, produced in it. This result cannot be effected with the mouth, but only with a table pyrogene.†

Alumina and Silica in P.

54. Berzelius proposes (p. 86) to estimate silica pyrognostically in a mineral thus:—"Every substance of an earthy or mineral nature, which melts with *soda* with effervescence into a transparent glass which remains transparent on cooling, is either silica or a silicate in which the oxygen of the silica is at least double the quantity of that of the base." This ingenious discovery, which is strictly correct in cases where it is applicable, and in such cases therefore most useful, is unfortunately inapplicable to those silicates in which the estimation of the silica is of the most importance. The so-called "alkaline earths," especially *lime*, will not permit silica, though combined in any proportion, to yield a bead with soda transparent on cooling, and they seem also to prevent or cancel effervescence in the same.

55. After many comparatively futile attempts to separate and estimate alumina and silica in various ways, one of which is referred to in par. 18. which occupied the writer some years, the following plan, which ought from its simplicity to have suggested itself at first, has been followed with apparent success. Nearly every oxide or substance is more soluble pyrologically in P than alumina and silica, while alumina is far more soluble than silica is. The "alkaline earths" are rapidly dissolved; and lime especially is not only dissolved, but forms a salt, referred to in par. 39, which will dissolve almost anything but silica.‡

56. It has been ascertained that alumina will dissolve to the extent of 20 per cent, and silica to that of only 6 per cent, in a P bead; and this result is not materially modified by lime. After those amounts respectively have been added, the undissolved alumina appears as white roundish fragments, like pieces of fat, the silica as a semitransparent mass like melting snow, so that they are thus distinguished without difficulty even in presence of lime or the alkaline earths. Six per cent is therefore taken as the standard of silica in quantitative calculations; but as 20, that of alumina, is inconveniently large, it is better to employ as the flux a P bead half saturated with 10 per cent of pure alumina, and to make 10 the standard of that "earth."

57. A P glass saturated with silicic acid still dissolves a little alumina, but the converse is not the case; it is best, therefore, to test *qualitatively* for either earth with a P glass saturated with *alumina*.

(To be continued.)

* Another mode of procedure with sulphides is to carefully add the roasted ore (which by a method of roasting to be hereafter described, *invariably* loses *just* 17 per cent), atom by atom, to the P bead, in a P. P. (when the CuO blue reaction will *first* appear), until the FeS *begins* to interfere with it; then deduct from the large amount of copper thus indicated the sulphur and iron as determined by roasting and protoxide of lead.

† Such as are sold at Freiberg by "Herr Bergmekanikus Lingke," manufacturer to the Royal University of that place; *vide* Plattner's "Probirkunst mit dem Löthrohre," vierte Auflage (Leipzig, 1865), p. 31, note.

‡ Borax dissolves silica pyrologically more completely than any known flux. The writer found that phosphoric and nitric acids, combined in about equal proportion, attacked and broke up the Berlin saucers in which they were boiled.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 6th, 1873.

Dr. WILLIAMSON, F.R.S., Vice-President, in the Chair.

AFTER the minutes of the previous meeting had been read and confirmed and the donations to the Society announced, the names of Messrs. James Walker Montgomery, Alexander Bottle, Richard Joseph Deely, and George Ainsworth, were read for the first time; for the third time, Messrs. Charles Lees, John Abigal Bower, Miles H. Smith, George Frederick Ochacht, Alfred J. Cownley, and Walter E. Koch, who were ballotted for and duly elected.

The first communication was from Dr. H. E. ARMSTRONG, "*On the Action of Sodium on Aniline.*" The author said that he was induced to lay before the society the results of his experiments on this subject some years ago, as Messrs. Merz and Weith had recently stated that sodium had no action on aniline. This was correct for temperature below the boiling-point of aniline, but when the two substances are heated in a sealed tube to 200°, the sodium disappears, hydrogen is evolved, and a colophonium-like substance produced, which appears to be a mixture of—

$$N\begin{cases}C_6H_5\\Na\\H\end{cases} \quad \text{and} \quad N\begin{cases}C_6H_5\\Na\\Na\end{cases}$$

It darkens when exposed to the air, and is decomposed by the action of water, with formation of sodium hydrate and reproduction of aniline. With methyl-aniline the action is only partial even at 250°, and with ethyl-aniline there is no action even at 300°. The simultaneous action of potassium and carbonic anhydride on aniline gives rise to potassium carbonate and diphenyl carbamide—

$$N_2(C_6H_5)_2H_2CO.$$

The latter substance, however, is not always produced, and even under favourable circumstances the amount is but small.

The CHAIRMAN, after thanking Dr. Armstrong for his interesting communication, announced that a paper "*On Anthrapurpurine*" would now be read by the author, Mr. W. H. PERKIN. After adverting to a paper in which he had mentioned the existence of another colouring matter, differing from alizarine, which was present in crude artificial alizarine, the author stated that he had endeavoured to extract it by repeated crystallisation of the alizarine from various solvents, but, although its solubility differs considerably from that of alizarine, he had been unsuccessful. The method of preparation ultimately adopted was to dissolve the crude colouring matter in a dilute solution of sodium carbonate, and agitate it with freshly precipitated alumina, which removes the alizarine in the form of a lake, and precipitate the impure anthrapurpurine from the filtered solution by hydrochloric acid. This product was purified by repeatedly boiling it with alcohol, crystallising the residue from glacial acetic acid, boiling it with alcoholic soda and decomposing the difficultly soluble sodium compound with barium chloride. The barium compound was lastly decomposed by sodic carbonate, and the resulting purple solution precipitated by hydrochloric acid. The product obtained, after being crystallised two or three times from glacial acetic acid, was found to have the composition $C_{14}H_8O_5$. *Anthrapurpurine* sublimes with partial decomposition when heated, is difficultly soluble in alcohol and in ether, but soluble in hot glacial acetic acid, which deposits it in tufts of minute orange-coloured needles. When heated with acetic anhydride to 150° it dissolves, forming *triacetyl-anthrapurpurine*, $C_{14}H_5(C_2H_3O)_3O_5 = C_{20}H_{14}O_8$, a substance crystallising in pale yellow glistening scales, which melt at 220°-222°. It is moderately soluble in glacial acetic acid, and is decomposed when heated with

alkalies, anthrapurpurine being regenerated. It dissolves in strong nitric acid, forming a dark yellow solution, which yields a pale brown precipitate when diluted with water. Diacetyl-alizarine, treated in a similar manner, yields a crystalline compound, which dyes alumina mordants a bright orange. By treating anthrapurpurine with benzoyl chloride, a corresponding crystalline *tribenzoyl-anthrapurpurine*, $C_{14}H_5(C_7H_5O_3)_3O_5 = C_{35}H_{20}O_8$, is obtained of a dark yellow colour. It melts at 183°-185°, and is moderately soluble in glacial acetic acid. From these results the author inferred that anthrapurpurine may be regarded as anthraquinone in which three of hydrogen are replaced by three of HO, so that it would have the formula $C_{14}H_5O_2(HO)_3$, and is probably derived from a trisulpho acid of anthraquinone. When heated with aqueous ammonia to 100°, a dark purple-coloured compound is obtained, which is probably isomeric with Dr. Stenhouse's purpurine. The author also gave a brief account of the action of bromine and nitric acid on anthrapurpurine, and concluded with a description of the absorption-spectra of anthrapurpurine and of its dyeing properties. The paper was illustrated by many striking experiments.

Dr. WILLIAMSON, in thanking Mr. Perkin for his interesting contribution to the history of the colouring matters, said it was a matter of surprise to him that the author exhibited such activity in contributing to the extension of the domain of science whilst he was at the same time conducting manufacturing operations on an extensive scale.

The next paper, on "*Isomerism in the Terpene Family of Hydrocarbons*," was read by the author, Dr. C. R. A. WRIGHT. The investigation detailed in the paper was made with the hope of obtaining some insight into the isomerism of the various members of the terpene hydrocarbons, and for this purpose the oils of nutmeg and orange-peel were selected for examination. By careful fractional distillation of the former, hydrocarbons boiling between 163° and 166°, and 173° and 177°, were obtained, also an oxidised substance, the *myristicol* of Dr. Gladstone, boiling between 212° and 218°, but this appears to become polymerised by repeated distillation. On treating the fraction between 163° and 166° with concentrated sulphuric acid to polymerise the terpene, a certain quantity of a hydrocarbon boiling between 173° and 177° was ultimately obtained. This, which amounts to about 8 per cent, had all the properties of cymene.

On fractionally distilling the oil of orange-peel, almost the whole passed over between 175° and 180°, the proportion of the oxidised constituent corresponding to myristicol being but very small. The hydrocarbon, *hesperidine*, from this oil does not appear to contain any cymene, as it yields no terephthalic acid on oxidation; on submitting it to the action of potassium dichromate and sulphuric acid, much carbonic acid is evolved, and a somewhat viscid oil remains, which by fractional distillation yields an oxidised compound, $C_{10}H_{16}O$. The hydrocarbon from nutmeg oil, boiling between 163° and 166°, when treated in a similar manner, yields a small quantity of an oxidised substance closely resembling myristicol. By the action of dilute nitric acid on hesperidene, *hesperisinic acid*, an acid analogous to camphresenic acid, is obtained, whilst the hydrocarbon from nutmeg oil by similar treatment yields toluic and terephthalic acids, and a new acid, *myristicinic acid*. Hesperidine combines readily with gaseous hydriodic acid, but does not form a crystalline compound, and, when treated with hydriodic acid and phosphorus, becomes polymerised. The author infers from the results of his examination that the hydrocarbons from turpentine, nutmeg oil, and orange-peel are truly isomeric, and concludes his paper with some remarks on the possible dissected formulæ for the isomerides of the general formula $C_{10}H_{16}$.

The CHAIRMAN, after thanking the author for his elaborate research on this interesting and important subject, adjourned the meeting until Thursday, Feb. 20, when the following papers will be read:—"On Aurin," by R. S. Dale and Dr. C. Schorlemmer, F.R.S. "Researches on the Action of a Copper-Zinc Couple on Organic Bodies; I. On Iodide of Ethyl," by Dr. Gladstone and A. Tribe. "Solidification of Nitrous Oxide," by Mr. Wills. "Action of Hydrochloric Acid on Codeine," by C. R. A. Wright.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 7th, 1872.

J. P. JOULE, D.C.L., LL.D., F.R.S., &c., President, in the Chair.

MR. JULIUS ALLMANN was elected an ordinary member of the Society.

The PRESIDENT referred to the great loss which the Society had experienced by the death of one of its most distinguished honorary members. Dr. Rankine was one of the earliest investigators of the dynamical theory of heat, and contributed eminently in the work of bringing that theory to its present advanced condition. Besides this, he was perhaps more successful than any other man in applying his own discoveries, and those of his fellow labourers in abstract science, to practical use. His treatises on the steam-engine and other prime movers, applied mechanics, machinery, &c., form what may justly be termed an encyclopædia of civil engineering. Called away in the prime of life, his loss is one of the most severe that could have befallen science.

Mr. WILLIAM H. JOHNSON, B.Sc., called attention to the action of sulphuric and hydrochloric acids on iron and steel.

If, after immersion for, say, ten minutes in either of these acids, a piece of iron or steel be tested, its tensile strength and resistance to torsion will be found to have diminished. Exposure to the air for several days or gentle heat will, however, completely restore its original strength. On breaking a piece of iron wire after immersion in sulphuric acid, and gently moistening the fracture with the tip of the tongue, bubbles of gas arise causing the wetted portion to appear to boil. The most careful washing and coating with lime, after being dipped in the acid, and even its subsequent drawing, in which process it is reduced in diameter by passage through a die, does not interfere with either of these phenomena; which only gradually disappear by exposure to the air, or more quickly by gentle heat.

Prolonged immersion in acid has a tendency to produce a crystalline structure in even the best wrought-iron.

NOTICES OF BOOKS.

Ozone and Antozone; their History and Nature. By C. B. FOX, M.D. London: J. and A. Churchill.

FEW bodies have, during the past thirty years, engrossed a larger share of the attention of chemists, meteorologists, and physicians, than the subject of this elaborate monograph. Yet how small is the amount of definite results which have been attained. We know, indeed, that ozone is oxygen in an allotropic state, and that these two bodies can be mutually converted into each other without either the addition or withdrawal of any other body; we are acquainted with certain of its reactions and with divers methods for its preparation. We consider it highly probable that its formation depends on the condensation of oxygen into two-thirds of its former volume. We consider that antozone is not, as was first supposed, a mere antagonistically active form of oxygen, but a peroxide of hydrogen. But having advanced so far, we abandon the region of science for that of conjecture and contradiction. If we ask when is ozone observed in the atmosphere, we

are told by one authority that it is always present, and that the "variation in its amount is inappreciable," whilst another observer pronounces it "an element of the most fluctuating quantity." Some find it most plentiful during the prevalence of northerly, and others of southerly winds. At Versailles, it was observed to be most abundant in summer; at Strasburg, in spring, and elsewhere in winter. Prestel finds its yearly maxima at the equinoxes and its minima at the solstices.

Nor, if we turn to the consideration of its supposed sanitary effects, do we find much greater agreement. It is, indeed, generally admitted that the air of large cities contains little or no ozone, whilst in country districts, on the coasts, and out at sea, it is comparatively abundant. In hospitals, especially in the fever wards, it is almost entirely absent. From such circumstances, and from its admitted power of destroying unpleasant odours, it is ordinarily pronounced to be "nature's grand disinfectant," and its presence is considered a safeguard against the spread of zymotic disease. Thus, according to Dr. Moffat, the cattle-plague was found most prevalent in those parts of England where ozone is generally supposed to be least plentiful. But all this, as the author reminds us, is far from proved. Thus at Königstadt, an unhealthy town, ozone was found as abundantly as upon the healthiest mountain. At Vienna, "a city noted for its lung-diseases and typhoid fevers," the indications of ozone were more decided than at Prague, "which is justly ranked with the healthiest towns." "We are not *sure*," says the author, "that ozone possesses the power of oxidising the *materies morbi* of any known affection."

Before these and kindred questions can be finally decided, our observations of the presence and quantity of ozone in the atmosphere must be freed from their discrepancies and contradictions. To do this our test-methods stand in need of a thorough verification. Into this part of the subject Dr. Fox enters at some length, pointing out the circumstances under which they become untrustworthy. For these precautions and for many valuable suggestions on the mode of observation, we must refer to the work itself.

Year-Book of Pharmacy, with the Transactions of the British Pharmaceutical Conference. London: J. and A. Churchill.

A valuable abstract of researches, novelties, and improvements, interesting to the pharmaceutical profession, arranged under the heads of *materia medica*, pharmaceutical chemistry, pharmacy, and "notes and formulæ." The transactions of learned societies and the scientific journals, foreign as well as British, appear to have been carefully explored for useful and appropriate matter. The opening address of Mr. Brady, at the Brighton Pharmaceutical Conference, and the papers on pharmaceutical education read by Messrs. Attfield, Schweitzer, and Proctor, are of deep interest beyond the immediate boundaries of the pharmaceutical profession. We gladly hail the denunciation of "cram" and the admission that—"Examination *per se* never was, and probably never can be, a thorough test of competency," a dictum which ought to be inscribed in letters of gold over the door of every college in the land. But whilst congratulating our pharmaceutical friends on the advance they have made, and on their success in raising their *status*, we cannot help putting the question whether some corresponding movement cannot be made among "analytical and consulting chemists?" Is it impossible for us to prevent the intrusion of incompetent persons from without, and to establish a code of professional ethics within? It is painful to hear of analytical chemists offering to perform investigations for fees which cannot cover the outlay for pure reagents, and asking a client the significant question, "whether he is buying or selling" the sample which he brings for analysis. We shall be glad to hear the opinions of our readers on this important subject.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, February 3, 1873.

This number contains the following original papers and essays relating to chemistry:—

Some Phosphuretted Combinations of Zinc and Cadmium.—B. Renault.—In the introduction to this paper the author gives a brief *resumé* of his former researches on this subject (*Ann de Chimie et de Phys.*, 4th series, vol. ix.). The contents of this paper record more particularly the researches on the phosphurets of cadmium, of which two are mentioned, viz., Cd_3Ph, a metallic-looking substance, soluble in dilute acids, and giving off phosphuretted hydrogen, detonates when struck by a hammer and mixed with oxidising substances. CdPh, a carmine-red coloured, silky-looking substance, which also yields phosphuretted hydrogen when treated with dilute acids. The chemical and physical properties of the phosphurets of cadmium are similar to those of the corresponding zinc compounds.

Synthesis of Organic Substances which have the Property of Optical Rotation. Production of Levo- and Dextro-Rotating Tartaric Acids by Starting with Olefiant Gas.—E. Jungfleisch.—This lengthy essay treats on a somewhat complicated method of converting first, olefiant gas into succinic acid and this, next, into tartaric and racemic acids. It appears that these acids thus artificially obtained are in every respect identical with the same bodies as are naturally formed. It also appears that the optical power of rotation can be produced without the intervention of life.

Description of a Meteoric Stone which fell in Southern Africa in 1862.—Observations on Enstatite or Chaldnite.—L. Smith.—A great portion of this paper is devoted to the account of the finding of this stone, and its being ultimately placed in the museum at Cape Town. The sp. gr. of this mineral is 7·692; composition in [illegible]: iron, [illegible]; nickel, 1·094; cobalt, 0·53; copper, a trace; phosphorus, 0·28. Enstatite, one of the lithoid components of meteoric stones, has the formula—$\dot{R}\ddot{S}i,MgSi$; bronzite, $\dot{R}\ddot{S}i(MgFe)\ddot{S}i$; olivine $\dot{R}_2\ddot{S}i_2(MgFe)_2\ddot{S}i$.

Journal für Praktische Chemie, Nos. 17 and 18 (double number), 1872.

This number contains the following original papers and memoirs:—

On Coal-Tar Pitch.—Dr. E. A. Behrens.—The continuation and end of a lengthy essay on this subject.

Technico-Chemical Gas Analysis.—Dr. C. Winkler.—This monograph, illustrated by woodcuts exhibiting apparatus devised by the author, is divided into the following sections:—Aqueous vapour, carbonic acid; nitrogen, sulphurous acid, oxygen, nitric oxide, and nitrous acid; chlorine; hydrochloric acid; ammonia; sulphuretted hydrogen; oxide of carbon.

Dextrine.—C. Barford.—The main gist of this essay may be summarised as follows:—The purity of dextrine; its freedom from grape sugar, can be tested by means of acetate of copper; pure dextrine can ferment when yeast is added to a solution of it, but the fermentation is slow; only carbonic acid is given off; the dextrine is not first converted into grape sugar.

On Molybdate of Ammonia.—L. Kaemmerer.—This paper treats chiefly on a salt spontaneously formed in a solution of ammoniacal molybdate, which had been used in the estimation of phosphoric acid. The percentical composition of the salt alluded to is:—Molybdic acid, [illegible]; ammonia, [illegible]; water, 3·357; formula, $NH_4O_3MoO_3+HO$.

Nature of the Gas used for Inhalation (Medicinally) in the Inselbad at Paderborn, Westphalia.—Dr. E. v. Meyer.—A series of tables exhibiting the composition of gases evolved from certain natural springs, and collected in gas-holders for medical use.

Some of the Nitrogen Compounds of Anthrachinon.—R. Boettger and Th. Petersen.—The second instalment of a lengthy essay on this subject, divided into the following sections:—α-mononitro-anthrachinon, $C_{14}H_7(NO_2)O_2$. α-monoamido-anthrachinon, $C_{14}H_7(NH_2)O_2$; α-diazo-anthrachinon-nitrate, $C_{14}H_7N_2O_2.NO_3$; behaviour of α-mononitro-anthrachinon with concentrated sulphuric acid.

Cause of the Coagulation of Milk Casein by Rennet, and on the So-Called Amphoterous Reaction.—W. Heintz.

Formation of Metanitro-Benzoic Acid during the Nitration of Benzoic Acid.—P. Griess.—This paper treats on the method of separating metanitro-benzoic acid from nitro-benzoic acid.

Researches on the Gases Occluded in Saar Coals.—Dr. E. v. Meyer.—This paper, chiefly a collection of tables exhibiting results of analysis, records researches on the gases occluded in the coals from Saarbrücken district, and on the composition of the air in the pits.

Bayerisches Industrie und Gewerbe-Blatt, January, 1873.

This number does not contain any original papers relating to chemistry.

Polytechnisches Journal von Dr. E. M. Dingler, second number for January, 1873.

Estimation of the Alkali Contained in Beet-Root Juice.—J. Vivien.—Illustrated by woodcuts.

Simplified Apparatus for the Estimation of the Value of Raw Sugar.—Dr. Schiebler.

Indelible Ink.—Dr. Bœttger.—3·65 grms. of aniline black are rubbed down in a porcelain mortar with 60 drops of concentrated hydrochloric acid, and 22 grms. of alcohol. This solution is mixed with a hot solution of 1·82 grms. of gum-arabic in 8·8 grms. of hot water. This ink does not attack steel pens, and is not acted upon either by strong mineral acids or by alkalies. If the aniline black solution is diluted with shellac solution (21 grms. in 85 of alcohol), an aniline black lake is obtained, which is suited for colouring wood and leather.

Bulletin de la Société Chimique de Paris, February 5, 1873.

This number contains the following original papers and memoirs:—

On some Reactions of Pyruvic Acid.—P. de Clermont.—After briefly referring to the labours of Wislicenus and others on this subject, the author treats on dibromopyruvic acid obtained by the action of chlorine upon dibromolactic acid. The first-named acid is a solid crystalline body, fusion-point 93°, formula $C_3H_2Br_2O_3$; its formation is elucidated by the following formula:—

$$\underbrace{C_3H_4Br_2O_3}_{\text{Dibromolactic Acid.}} + Cl_2 = \underbrace{C_3H_2Br_2O_3}_{\text{Dibromopyruvic Acid.}} + 2HCl.$$

When pyruvic acid is treated with hydrochloric acid at 100° under pressure (sealed tubes), the result is the bromated pyruvic acid; which, however, exhibits in this instance a somewhat higher fusion-point, viz., 112°. When sulphopyruvic acid and sulphopyruvate of baryta are treated at 100° with an aqueous solution of bromine (under pressure), there is formed a bromated sulphopyruvic acid, a liquid, and a crystalline bromated sulphopyruvate of baryta.

Preparation of Propylenic and Butylenic Bromides.—L. Prunier.—This essay treats exhaustively on the method of preparing the above-mentioned compounds, which are best obtained in crude state by first dissociating, by means of red heat, the vapours of the petroleum oils, boiling at from 60° to 90°. The fluids thus obtained are then submitted to fractional distillation, and lastly bromated. The petroleum oils alluded to yield ethylen, propylen, and butylen.

Bibliography.—Under this heading we notice the following works:—"Leçons de Chimie Elémentaire Appliquée aux Arts Industriels, par M. J. Girardin Recteur de l'Académie de Clermont, &c. Cinquiéme édition entièrement refondue, avec figures dans le texte: 5 vols. in 8vo. Three of these are published, and each volume may be had separately. This work is one of the best of the kind ever published, and contains very valuable historical notices. "Leçons de Chimie Agricole, études sur l'Atmosphère, le Sol, et les Engrais," par A. Bobierre, Professeur de Chimie à Nantes. "Simples Notions sur l'achat et l'emploi de Engrais Commerciaux," par A. Bobierre. These works are highly spoken of, and are recommended to all interested in agricultural science. The above works are all published by G. Masson, Paris.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, January 2, 1873.

This number contains nothing relating to chemistry, but we call attention to the two following papers:—

Improved Steam-Boiler Provided with a Double Water Compartment (à Double Nappe d'eau).—M. Felix.—The description of a high-pressure steam boiler devised for the prevention of boiler incrustation, as well as deficiency of water.

Atmospheric Coal-Winding Machine.—*Z.* Blauchet.—The last part of a detailed account of a mechanism contrived to supersede the ordinary methods used for bringing to bank the coal wrought in pits. We learn from the statistics here given, that this atmospheric system saves a great deal of labour, and is far more effectual than the plans now in use.

Les Mondes, February 6, 1873.

No original matter relating to chemistry is contained in this number, but we call attention to the paper on—

The Dry Fog (Callina of the Spainards; Hohenrauch or Haarruch of the Germans).—M. Collas.—This essay treats on a phenomenon known in Holland as "veendamp," a peculiar kind of fog; the cause of which, in North Western Germany, Holland, and adjacent countries, is in part due at least to the burning of peat-bog soil in early spring for the purpose of preparing the soil for buckwheat sowing; but in Spain, Mexico, and other countries, the author states that this fog is caused by cosmical influences.

The Flints of the Meudon Chalk and Boulder Stones with Impressions.—M. Choyer.—A geologico-geognostical essay.

Artificially made Stone.—L. Mignot.—This exhaustive paper is mainly published to prove that the author is the first who, by dissolving flints in caustic alkali, has applied this solution to the preparation of various kinds of artificial stones and other building materials. Among the preparations mentioned he quotes ceramic glue, which when applied to glass and dried adheres so tenaciously that the glass scales off when the glue is attempted to be removed.

Obituary.—Under this heading we are informed of the death of M. Clerget, who for many years held the position of scientific adviser to the Administration des Douanes in France, and who introduced the optical saccharometer (Soleil's) for the purpose of ascertaining the value of raw sugar.

La Revue Scientifique de la France et de l'Etranger, February 1, 1873.

The only paper bearing upon chemistry is:—

On the Cost of Manure, and on the Condition of Agricultural Property in France.—G. Ville.—A valuable paper on practical agriculture.

Le Moniteur Scientifique Quesneville, February, 1873.

This number contains the following original papers and memoirs relating to chemistry:—

Present Condition of Agricultural Science in France, and other Countries.—L. Mussa.—The first instalment of an agronomical monograph. This portion treats on phytophysiology.

Presence of Silver in Subnitrate of Bismuth.—Ch. Ekin.—After observing that the preparation alluded to often contains silver, of which, however, no notice is taken in most works on pharmacy, the author states that having tested many samples for the purpose of detecting the presence of a silver compound (subchloride), he found some samples of the subnitrate (basic nitrate, bismuthum-hydiconitricum) to contain from 3·9 to 6·5 per cent of subchloride of silver; and in other samples he found some metallic silver in a finely divided state, but in a small quantity. It appears that these impurities are for the most part due to an imperfect method of preparing the subnitrate of bismuth. It is well known that metallic bismuth often contains silver.

MEETINGS FOR THE WEEK.

Monday, Feb. 17th.—Medical, 8.
—— London Institution, 4.
Tuesday, 18th.—Civil Engineers, 8
—— Royal Institution, 3. Prof. Rutherford, "On Forces and Motions of the Body."
—— Anthropological, 8.
—— Zoological, 8½.
Wednesday, 19th.—Society of Arts, 8.
—— Meteorological, 7.
Thursday, 20th.—Royal, 8½.
—— Royal Society Club, 6.
—— Royal Institution, 3. Dr. Armstrong, "Formation of Organic Substances."
—— Zoological, 4.
—— Chemical, 8. R. S. Dale and Dr. C. Schorlemmer, "On Aurine." Dr. Gladstone and A. Tribe, "Researches on the Action of the Copper-Zinc Couple on Organic Bodies: I. On Iodide of Ethyl." Mr. Wills, "Solidification of Nitrous Oxide." Dr. C. R. A. Wright, "Action of Hydrochloric Acid on Codeine."
Friday, 21st.—Geological, 1. (Anniversary.)
—— Royal Institution, 9. Prof. Clerk Maxwell, "On Action at a Distance."
Saturday, 22nd.—Royal Institution, 3. Dr. Edward A. Freeman, D.C.L., "On Comparative Politics."

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THE CHEMICAL NEWS.

VOL. XXVII. No. 691.

ON A

NEW RELATION BETWEEN HEAT AND ELECTRICITY.*

By FREDERICK GUTHRIE.

IT is found that the reaction between an electrified body and a neighbouring neutral one, whereby the electricity in the neutral body is inductively decomposed and attraction produced, undergoes a modification when the neutral body is considerably heated.

Under many circumstances it is found that the electrified body is rapidly and completely discharged. The action of discharge is shown to depend mainly upon the following conditions :—(1). The temperature of the discharging body, and its distance from the electrified one. (2). The nature (+ or −) of the latter's electricity.

With regard to (1), it is shown that the discharging power of a hot body diminishes with its distance and increases with its temperature. But, concerning the temperature, it is proved that the discharging power of a hot body does not depend upon the quantity of heat radiated from it to the electrified body, but chiefly upon its quality. Thus a white-hot platinum wire connected with the earth may exercise an indefinitely greater discharging power, at the same distance, than a large mass of iron at 100° C., though the latter may impart more heat to the electrified body.

Neither the mere reception of heat, however intense, by the electrified body, unless the latter have such small capacity as to be itself intensely heated, discharges the electricity if the source of heat be distant, nor is discharge effected when the electrified body and a neighbouring cold one are surrounded by air through which intense heat is passing; but, for the discharge, it is necessary that heat of intensity pass to the electrified body from a neutral body within inductive range.

White- and red-hot metallic neutral bodies exercise this discharging power even when isolated from the earth, but always with less facility than when earth-connected.

The hotter the discharging body, whether isolated or earth-connected, the more nearly alike do + or − electricities behave in being discharged; but at certain temperatures distinct differences are noticed. The − electricity, in all cases of difference, is discharged with greater facility than the +.

Attempts are made to measure the critical temperatures at which earth-connected hot iron (1) discharges + and − electricity with nearly the same facility, (2) begins, as it cools, to show a preferential power of discharging −, and (3) ceases to discharge −. The temperatures so obtained are measured by the number of heat-units, measured from 0° C. in 1 grm. of iron of the respective temperature, represented by the value of the expression $Fe\sum_{0}^{t} u$.

It is shown that various flames, both earth-connected and isolated, have an exceedingly great power of discharging both kinds of electricity.

The effects in regard to discharge are shown to be similar when platinum-wire, rendered hot by a galvanic current, is used, and also when the condensed electricity of a Leyden jar is experimented on.

As hot iron shows a preferential power of discharging − over + electricity, so it is found that white-hot, but isolated, iron refuses to be charged either with + or − electricity. As the iron cools, it acquires first the power of receiving −, and afterwards of receiving +. Further, while white-hot iron in contact with an electrified body prevents that body from retaining a charge of either kind of electricity, as it cools it permits a + charge to be received, and subsequently a − one.

A suggestion is made as to the existence of an electrical coercitive force, the presence of which, together with its diminution by heat, would explain much of what has been described.

* Abstract of a Paper read before the Royal Society.

QUANTITATIVE ESTIMATION OF MANGANESE IN IRON ORES, PIG-IRON, AND STEEL, BY MEANS OF A COLORIMETRIC PROCESS.

By P. PICHARD.

I WEIGH off 0·1 grm. of pig-iron, cast-iron, or steel which has previously been very finely pulverised; the substance is strongly ignited in a small porcelain or platinum crucible, so as to effect a roasting as well as oxidation. After cooling, it is carefully and intimately mixed with from 2 to 3 decigrms. of previously ignited dry carbonate of soda, and then again ignited at a very high temperature. I add to the cooled, fused, or sintered mass 5 c.c. of concentrated nitric acid and one drop of hydrochloric acid; the iron and manganese become dissolved after a few hours, an operation which may be greatly assisted by placing the crucible in a warm situation. As soon as no matter is adhering to the sides of the crucible, its contents are poured into a glass tube, 20 centims. in length and from 15 to 18 m.m. in diameter, and closed at one end; the crucible is well washed with boiling water. The tube and contents are heated to boiling over a spirit-lamp, so as entirely to dissolve all the manganese; when this has been effected, 10 c.c. of water are again added, and then half a grm. of peroxide of lead. The tube is then heated again, and its contents kept boiling for two or three minutes. The excess of peroxide of lead having settled, the clear liquid is decanted and poured into a graduated tube of 500 c.c. cubic capacity. The peroxide of lead left in the test-tube is washed with a mixture consisting of 1 c.c. of nitric acid and 5 c.c. of distilled water; if this should not yield a nearly colourless solution, the washing is repeated, and aided by boiling. The wash-waters are added to the solution first obtained, and the fluid contained in the graduated tube is thoroughly mixed by shaking the tube gently. This having been done, a standard solution of manganese, by treating, in the manner described, 7 milligrms. of the red oxide of that metal, a quantity corresponding to 5 milligrms. of manganese. The solution of permanganate of soda thus obtained is poured into a graduated tube of 500 c.c. capacity, and the fluid contained therein is diluted with water until the hue of the liquid corresponds exactly to that of the iron or other substance under trial. In order to judge distinctly of the colour, the tubes are held next to each other, and a sheet of white paper close to them. The number of divisions of the tubes occupied by fluid having been read off, the quantity of manganese sought for is found by the use of the following equation :—

$$\frac{x}{5} = \frac{V}{V'}, \quad x = \frac{5V}{V_t}$$

x being the unknown quantity, and V the volume corresponding thereto; V_t the volume of the standard solution corresponding to 5 milligrms. of manganese. The quantity of manganese is found in centièmes (hundredths). As in many manganiferous iron ores the proportion of manganese present rarely exceeds 5 per cent, and is seldom even so high in cast-iron, pig-iron, or steel, calculation can be dispensed with by at once diluting the standard solution to 500 c.c. (the colour is even then very marked). The liquid to be tested is then diluted until the colour is

precisely the same; by reading off the number of divisions occupied by the liquid, the percentage of manganese is at once found. Since 500 c.c. of the standard solution correspond to 5 milligrms. of manganese, 1 c.c. corresponds to 0·00001 grm., say, for 0·1 grm. of mineral weighed off $= \frac{1}{10,000}$ of the total weight. If the volume of the liquid is 275 c.c., the proportion of manganese will be $\frac{275}{10,000} = 2{\cdot}75$ per cent. With a practised eye, it is not difficult to distinguish the hues of the liquors, even at that great degree of dilution, and the estimation of the manganese may be made to within $\frac{1}{10,000}$; at first, the estimation may even be made to within $\frac{1}{10,000}$. If it should happen that at a first assay the proportion of manganese is found below $\frac{1}{10,000}$, it is best to take larger quantities of material, say 3, 4, or 5 decigrms.; the quantity of carbonate of soda is, of course, proportionately increased, and the operation carried on as described above—the final result being divided by 3, 4, or 5. The standard solution may be kept for some days in a well-stoppered bottle, but gradually sesquioxide of manganese is deposited, and when this is the case the solution must be made afresh.—*Comptes Rendus.*

PROPOSED SUBSTITUTE FOR COAL-GAS.

We have recently had an opportunity of inspecting, in company with some sixty gentlemen interested in gas manufacture, the new process which is now being advertised so largely by a company which bears the title of "The New Gas Company, Limited." The works are on the premises of the Southwark and Vauxhall Water Company, at Battersea, and are well adapted for experiments upon a somewhat large scale.

The new Company proposes to purchase the patents of Mr. W. D. Ruck, which appear to have culminated in the process we are about to describe. Everything was explained to us with great courtesy, and although there were some points of imperfection in the experiments we witnessed, the trial was upon the whole a fair one as far as it went.

The apparatus consists of three iron gas retorts set in a single furnace, one over the other two. Close above the retorts, and heated to bright redness by the same fire, is a horizontal U-shaped iron pipe about 4 inches in diameter. The retorts are charged with a mixture of coke and iron, and steam from an ordinary boiler is then forced through the iron pipe, which it is obvious acts as a superheater. The superheated steam passes into the two lower retorts, being carried by pipes arranged in their axes to the further end, and then returning through the mass of heated coke and iron. It then traverses the third retort in the same manner, and in this way a large volume of gas is generated, which is cooled in a temporary condenser and carried to a gas-holder. It is then purified in the ordinary way.

The gas so obtained has of course no illuminating, though a very considerable heating value. It is, in fact, a mixture of hydrogen, carbonic oxide, and carbonic acid, the latter amounting, it is said, to about 12 per cent. To render it luminiferous, it is passed through a chamber containing rectified petroleum spirit of sp. gr. 0·68. Of course a considerable quantity of the vapour of this spirit is taken up, and the volume of the gas is increased, it is said, by about 25 per cent. The gas then burns with a brilliant flame, and is ready for distribution.

In regard to the merits of this scheme, it must be remarked, in the first place, that it does not present any points of absolute novelty. The decomposition of steam by red-hot carbon was correctly described by Clement and Desormes in 1809, and is familiar to all chemists. In 1839, Bunsen published an analysis of the gases produced; they consisted, in round numbers, under the circumstances of his experiment, of—Hydrogen, 56; carbonic oxide, 29; and carbonic acid, 15. The process, in one form or other, has been the subject of numerous patents. The reaction can be explained by one of two formulæ, according as carbonic oxide or carbonic acid is produced:—

$$(1). \quad H_2O + C = H_2 + CO.$$
$$(2). \quad 2H_2O + C = 2H_2 + CO_2.$$

In (1) the volumes of hydrogen and carbonic oxide formed are equal, and 1 ton of pure carbon should yield 2·5 tons of the mixed gases, they jointly having a sp. gr. of 0·519 (at standard pressure and temperature) and a volume of 133,659 cubic feet. If reaction (2) took place alone, two volumes of hydrogen to one of carbonic acid would be obtained. One ton of pure carbon would then yield 4 tons of the mixed gases, they having a sp. gr. of 0·554 and a total volume of 200,337 cubic feet. The volume obtained in either case would, of course, be somewhat greater at the ordinary temperature of the air. In practice, the two reactions take place, as chemical reactions so often do, side by side. The gas obtained by Bunsen must, at standard pressure and temperature, have possessed a sp. gr. of about 0·548.

The carburetting process is scarcely more novel. Of late years, methods for increasing the illuminating power of gas, by introducing the vapour of hydrocarbons, have been tried again and again, and a flourishing rival to the new Company is now trying to introduce the use of a gas made by passing common air through a similar petroleum spirit.

It must not be supposed, from the foregoing remarks, that we intend to assert the invalidity of Mr. Ruck's patents. We do not pretend to form any opinion upon this point. It often happens that a patent is perfectly sound, even when it embodies no original idea, some modification in the physical conditions constituting in the eye of the law a sufficient novelty to justify protection. Indeed, some such modification is often all that is necessary to convert a worthless into a highly valuable process. This was the case notoriously with the celebrated paraffin oil patent.

One of the gravest questions in regard to the new gas is whether and how far its illuminating power will stand the test of cold. The vapour introduced is, after all, a vapour, and as such capable of more or less complete condensation. Would any such condensation occur during cold weather, and if so, would its amount be sufficient to impair in any serious degree the value of the gas? It is well known that many carburetting schemes have failed from this cause, and although it may be that so light a spirit has not been employed before, the point is one that ought to be most clearly made out. The scientific advisers of the new Company assure us that they have tried the experiment of cooling, and also of storing the gas, without injuring its quality, but we confess we should like more complete and definite evidence in support of their assertion. The day upon which we saw the experiment was a very cold one, and more than 1000 yards of 3-inch main, all ready fitted, lay outside the building, having, we were told, been previously used for just such a trial. Why was not the gas passed through it? The experiment would have been peculiarly convincing on such a cold day, especially if the gas had been suffered to remain for four-and-twenty hours in the main.

The question whether or not the vapour will condense in material quantity in cold weather could only be answered by a knowledge of its tension at low temperatures. Upon this point we have no evidence before us, and are therefore unable to express an opinion.

Some doubt also hangs over another matter. The printed reports of the Company assert the superiority of its gas over the air-gas, because the latter, having about the same specific gravity as air, requires so much force to drive it through the pipes. And yet they do not tell us

the specific gravity of their own. If it be true that it contains 20 per cent of the vapour of liquid hydrocarbons, it is difficult to understand how the sp. gr. can be much less than that of common air. Hexane, for instance, C_6H_{14}, one of the largest constituents of petroleum spirit, has, at standard pressure and temperature, a vapour density very nearly three times that of the atmosphere.

The new process claims to effect a great saving in regard to expense. One ton of coal by the old process yields, in round numbers, 10,000 cubic feet of gas; whereas by the new, one ton of coke should yield from 130,000 to 150,000 cubic feet, or possibly even more. The result is stated in the prospectus to be that the labour of twenty-nine out of every thirty men will be saved. In another part of the same prospectus, we are, however, told that the saving of labour will be "to the extent of 50 per cent," so that there appears some ambiguity in the matter. Messrs. Quick and Son, the engineers, report, as the result of their experiments and calculations, that "gas of 16½ candle-power may be manufactured at a cost of 1s. 7¾d. per thousand cubic feet." Such a consummation is devoutly to be wished, but its realisation must obviously depend upon a somewhat complex set of conditions. The managers of the undertaking do not hope, we understand, to get their processes adopted in large English towns, for the present at any rate. Probably they are wise, for if they did they would at once be met with the difficulty,—Where is the necessary coke to come from if the old mode of gas-making be abandoned? Charcoal, or even wood, would hardly be proposed as a substitute in this country. In many foreign countries the case is very different, and it certainly appears possible, or even perhaps probable, that in places where wood is cheap and coal very dear, this process, or some slight modification of it, may be adopted with advantage.

One of our contemporaries, animadverting somewhat severely upon the new process, exclaims against the idea of introducing so deadly a poison as carbonic oxide into our houses. The point is one of great importance. It is true that ordinary coal-gas contains this poison to the extent of some 5 or 6 per cent. It is also true that carbonic oxide is completely converted into the comparatively harmless carbonic acid when burnt, but there is some difference after all between 5 or 6 per cent and 29, and the risk of an escape of gas would be materially increased by the presence in it of so large a quantity of such a deadly ingredient.

Here, again, we require more information, but we must admit that we hardly think it likely that the terrific results dreaded by our contemporary would be verified even if the new gas were introduced. Surely it is an exaggeration to say that "an escape of this gas, such as takes place in many houses every day with coal-gas, would be certain death to every one of the inhabitants."

In conclusion, we will remark that, although it has been our duty to present to our readers the chief doubts that beset us in regard to the new scheme, we are far from thinking it absurd or unworthy of trial; on the contrary, we would fain hope that under certain circumstances it may prove a valuable addition to our means of comfort.

PYROLOGY, OR FIRE ANALYSIS.*

By Captain W. A. ROSS, R.A.

(Concluded from p. 81).

Boric Acid (Symbol B).

58. Plattner and succeeding writers on the "blowpipe" made use of this substance for the purpose of separating metallic lead from copper, in an alloy of the two, by oxidising the former, and therefore as a means of *affinage* of the latter metal.† In this operation, B appears to absorb litharge precisely as bone-ash does in cupellation; but it acts at the same time as a kind of shield to protect the copper from oxidation.

59. Berzelius employed B as a test of phosphoric acid in phosphates by the insertion through the mass of a piece of pure iron wire, which is corroded and fused if the phosphoric acid exists over 5 per cent; but this reaction, to be effectual, presupposes the perfect solution of the substance containing the phosphate in B, which, as will be seen, can be effected with very few oxides indeed.

60. In fact it is precisely the insolubility of almost all substances but the alkalies in boric acid which gives it the extraordinary value it undoubtedly possesses as an agent of *separation*; and the following few examples will not only clearly demonstrate this fact to the impartial chemist, but show him that the fact itself has been utterly passed over by writers on the subject hitherto, and that the real analytical value of B, therefore, has remained unknown.

Oxides of Cerium, Didymium, and Lanthanum.

61. If a good specimen of the mineral "cerite" be powdered and applied to a bead of B in an O. P., the following phenomenon results. The substance appears to separate into three distinct parts:—(1) red-brown and resinous-looking round spots appear near, but not *on* the surface; (2) other round spots, more bulky or puffed out, nearer the middle of the bead, of a pale buff colour; (3) a slight milky turbidity through the bead, as though a finely divided precipitate were suspended throughout the whole mass. If what is sold or made by the chemists as "pure oxide of cerium" (generally a nut-brown powder) be applied to a B bead in like manner, precisely the same triplicate separation occurs, only the turbidity is very much less.

62. These round spots are observed to be round through a lens when viewed in *every* direction; they are therefore sphericles or globules.* After considerably long treatment with O. P. the smaller buff-coloured globules will be dissipated throughout the bead, causing more turbidity with a slight shade of buff in it; but the red resinous globules remain unchanged, appearing white-hot in the red-hot bead (from which it appears that their fusing-point is higher than that of B), and may be collected, from their superior specific gravity, at the bottom of the bead, by careful manipulation with the point of the blue pyrocone, into one large globule.

63. Professor Stokes has found that, by treating this B bead with distilled water, the general mass is dissolved, while the contained globules remain intact, the most minute of which may be thus perfectly extracted. They may be also extracted more quickly, but with less precision, by wrapping the bead when *quite* cold in paper, and tapping it gently upon an anvil with a light hammer, when the matrix breaks away from the globules. Added to a bead of P under O. P., the red globule first fuses to an intensely lemon-coloured mass on the surface, and then dissolves in the glass with effervescence, giving the reactions of ceric oxide. These red ceric globules have been discovered by Professor Stokes to contain also oxide of *didymium*, the absorption-bands of which, when spectroscopically examined, they show very distinctly.

64. It is therefore assumed that the red balls are composed of ceric + didymic oxides, and the buff-coloured ones of lanthanic oxide; while the turbidity is proved beyond reasonable doubt to be caused by lime, which with baryta are the only substances, except phosphoric acid, capable of causing this opaline turbidity on *first* application to the B bead.† At any rate, the so-called "pure oxide of cerium" is thus shown, by one simple operation, to consist in reality of no less than *four* substances.

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* Communicated by the Author. From the *Proceedings of the Royal Society*.

† *Vide* Plattner's "Probirkunst" &c., edition of 1865.

* This was written before the writer knew how to extract these globules: *vide* next paragraph.

† A trace of phosphoric acid applied to a bead of boric acid, and heated in O. P., affords a glass when cool having an almost perfect resemblance to an opal.

Lime, Strontia, Baryta, Alumina, Silica, and Magnesia.

65. Of the alkaline earths, lime, as above mentioned, causes immediate turbidity over the whole bead, and when added in greater proportion produces round spots suspended in the turbid mass. These spots are perfectly clear and colourless, like drops of limpid oil in milk. When added in very large proportion, the clear spots collect in one large one, which, if still further addition of lime is made, absorbs the remainder of the turbid part, leaving the whole bead beautifully clear and colourless. The turbid part, therefore, would appear to be an attempted solution of the lime by the boric acid; the clear part, a complete solution of the boric acid in the borate of lime.

66. Strontia forms large, beautiful, vitreous-looking globules, quite transparent and even refractive; they have great specific gravity, and can be easily aggregated at the bottom of the bead. Baryta affords sphericles like fish-eyes, transparent at first, but soon becoming opaque. Magnesia is not at first acted on by B, but after a short O. P. resolves itself into opaque, white, and compact sphericles, like miniature snow-balls; these, after long O. P., and consequent exhaustion of B, are clarified and become transparent, but are again rendered opaque by the addition of fresh B. It is concluded from this fact that these contained balls have a fixed relative proportion as regards quantity to the containing B. Alumina and silica remain as amorphous fragments, and do not congest into globules: those of the former are white and opaque, like pieces of fat; of the latter, semi-transparent.

The Alkalies.

67. Soda, potash, and lithia, appear to be the only substances which dissolve completely in boric acid in any proportion, and hence the value of the latter as a detective agent for them, and also as an alkalimeter; for if a very small trace of soda or potash contained in a mineral or salt be applied to a B bead having globules of cobalt (for instance) suspended in it, those nearest the side where the alkali is applied are dispersed and spread over that side as a pink suffusion. If 5 per cent be added, the sphericles of cobalt disappear, the whole bead is clarified, and assumes a blue colour while hot, but remains pink on cooling. If 17 per cent be added, the bead remains *blue* on cooling, and (in the case of soda) borax has been formed; but this method would probably be considered incomplete if it did not afford a means of distinguishing between, as well as of measuring, these two alkalies; and this it does as follows:—

Vesiculation.

68. If the B bead, on the addition to it of the substance to be examined, shows, by the reaction above described, that an alkali is contained in the latter, a fresh bead should be impregnated with a weighed portion of the substance, which should be dissolved as far as possible by an O. P. Then, the bead being rapidly removed from the point of the pyrocone, it should be blown into while red-hot with the jet of the pyrogene, which for that purpose should be advanced so as just to touch the ring of the platinum-wire. If the bead be not too cold, the result will be that the whole mass is blown out into a thin clear bubble or vesicle, about seventy times its first size, thus presenting a very large surface of the dissolved substance to be operated on. This vesicle should then be held in the operator's open mouth, and breathed upon for some time, when, if the alkali has contained even a trace of potash (1 per cent of KO affords the reaction), the vesicle will immediately become clouded over with a light blue film of the colour of a solution of quinine when held against the light. If only soda be present the vesicle will remain clear, but will begin to deliquesce. Lithia affords a tarnish like that of breath on a pane of glass, and the vesicle does *not* deliquesce.

69. This test for potash in presence of soda is so delicate that if two beads, even of borax, one containing a trace of potash, be vesiculated, and allowed to remain in a moderately dry room for some time, the one containing the potash will in the course of a few hours cloud over, while the other will remain quite clear.

Determination of Gases by Vesiculation.

70. The B vesicle by itself will cloud over after a few minutes, but the appearance then is more white than blue; and if the clouded vesicle be approached to the flame of a spirit-lamp, this white coating is not removed until the flame almost touches it and shrivels the substance of the vesicle, whereas in the case of the addition of a trace of potash, the cloud flies as if by magic when the vesicle is even a considerable distance off.

71. The addition of *chlorine* to the B bead, made by dipping the bead in strong hydrochloric acid and treating as in paragraph 48, apparently causes the vesicle made therefrom to be still more sensitive to the action of gases upon its surface. It clouds over in common air almost the instant it is made. If held over a solution of *ammonia* this nubilescence is prevented, and the vesicle remains clear. If held in a noxious or putrescent gas, creamy or brownish-white streaks are formed over the surface, which is otherwise clear. But the most characteristic reaction is that afforded by sulphuretted hydrogen, in an atmosphere of which this vesicle becomes rapidly pitted with circular spots, as though it had suddenly taken smallpox. These spots, through a lens, are observed to be round radiated crystals, with a yellowish tinge near the circumference. After a short time they rot into holes.

72. Another curious result of vesiculation is the crystallisation of the surface, in a moderately damp atmosphere, in the course of ten or twelve hours. Borax-vesicles show these best; but the complicated nature of the salts formed renders conclusions from their crystallisation very uncertain. Microscopically viewed, however, these crystals are very beautiful, especially in polarised light; and it seems at any rate certain that silica and the silicates thus treated invariably crystallise in most elegant and beautiful arborescent appearances, the form taken by other salts being usually that of a disk, often of a leaf.

Cobalt, Copper, and Metallic Oxides.

73. The behaviour of these in B has not yet been fully examined, but such as have promise results quite as interesting and important as those which may be derived from that of the earths. For instance, when an ore containing the oxides of cobalt and nickel, previously manipulated as in paragraph 90, is boracically treated as described in par. 61, the cobalt immediately congests into globules, which after O. P. appear blue-black, after H. P. red-purple through a lens; the nickel oxide, on the contrary, remains in amorphous fragments, which are bright green after O. P., and have a metallic lustre after H. P. Cupric oxide forms in O. P. balls of an indigo-blue colour, not easily distinguishable at first from those of cobalt; but in H. P. the cupreous globules immediately give out streaks of the red suboxide, which cannot be mistaken, though, of course, were further proof necessary, the addition of 5 per cent of soda would form a pink glass from the first, and a blue one from the second. Iron oxide remains in amorphous fragments of a black-brown colour with a rusty halo or tinge round them, and is thus easily distinguished. Oxide of uranium forms a stringy black mass with a yellowish opacity round, which the addition of soda dissolves to a bright pea-green bead. Molybdic acid affords many curious and beautiful changes, for a description of which there is not space.

Silver, Lead, and the Volatilisable Oxides.

74. None of these form either balls or fragments in boric acid, but spread over the whole bead as a milky precipitate, that of silver having a slight pinkish tinge. Nothing, therefore, can be easier than their separation thus from those metallic oxides which form balls or fragments, as the former of these can not only be collected or aggregated into one spheric, but extracted from the cold bead with the greatest ease, as described in paragraph 63.

It is obvious that this process would probably form an important method of extracting *silver* from its ores with very little loss; for the boric acid protects oxides contained in it from the direct effect of an O. P., which dissipates pure silver unprotected to the extent of 10 per cent in a very short time.

75. Altogether, as a detective reagent, boric acid seems scarcely inferior even to phosphoric acid, while as a separating one it is quite unsurpassed. Many hypotheses of the formation of these sphericles or balls have suggested themselves to the writer, but none with a sufficient weight of evidence in their favour to be stated here. They may be due (*a*) to capillary phenomena, (*b*) to the retention of a certain amount of carbonic acid (for of the "earths" it is evidently only those forming carbonates which produce them), or (*c*) to some law or principle as yet not fully known.

76. A bead of pure boric acid is evidently more fluid in H. P. than in O. P., and the hydrated appearance of cobaltine balls in the former (paragraph 73) would seem to suggest the setting free of some constitutional water (?).

Phosphate of Lime.

77. This is a useful flux for purposes of mere solution, as referred to in paragraph 39. A curious phenomenon results from the application to the hot glass, containing a metallic oxide in solution, of carbonate of soda, which, instead of fusing in the glass under O. P., does so by itself at first, apparently drawing or precipitating the metallic oxide to itself. If a hot glass of phosphoric acid be applied to warm calcined lime, the mixture takes fire and burns with a very pretty pale yellow light, phosphate of lime being formed. This flux has been little investigated for pyrological purposes, having been thus first used by the writer.

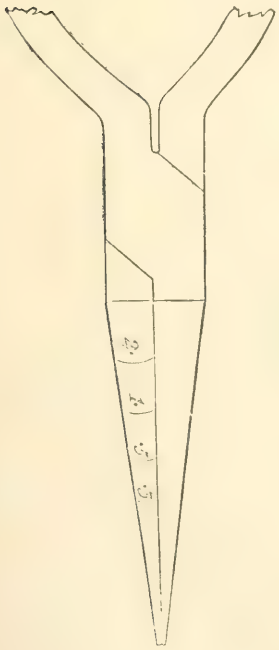


FIG. 6.

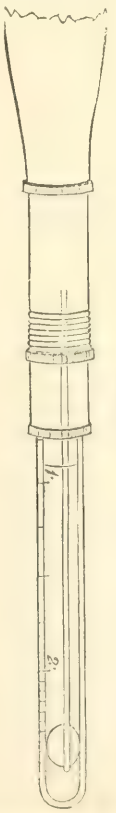


FIG. 5.

Quantitative Analysis by "Glasses" or "Beads."

78. For this purpose it is evident that the glass must not only be weighed, but measured; for, as both phosphoric and boric acids lose weight and substance in direct proportion after a strong O. P., some means of measuring the diameter of the bead, and of thus keeping it up to the mark, is required. Sufficient accuracy for this purpose seems to be afforded by a simple instrument, as that shown in Fig. 5, representing a common glass tube which exactly covers a 50-mgr. bead of phosphoric acid. The graduations on the outside of the tube are for the purpose of showing the length of the platinum-wire (in tenths of an inch), which of course is proportional to its weight, the thickness or diameter being the same.

79. Fig. 6 represents the instrument with which the platinum-wire is twisted into a loop, which must be perfectly circular, and of a diameter corresponding to the size of glass required. It is a pair of common cage-maker's pliers, with round but tapering legs; only the right (or left) leg should be graduated and figured, say, in tenths of an inch, to show the diameter of the loop made on the other one. Neither of these instruments, however, is to be understood as at all dispensing with the use of the assay balance, of which a beautifully portable description is now made cheaply at Freiberg; it indeed is indispensable, and to be referred to when any doubt is entertained.

Roasting through *Platinum-Foil.*

80. The cautions and directions against using the platinum which is supplied as part of all pyrological appa-

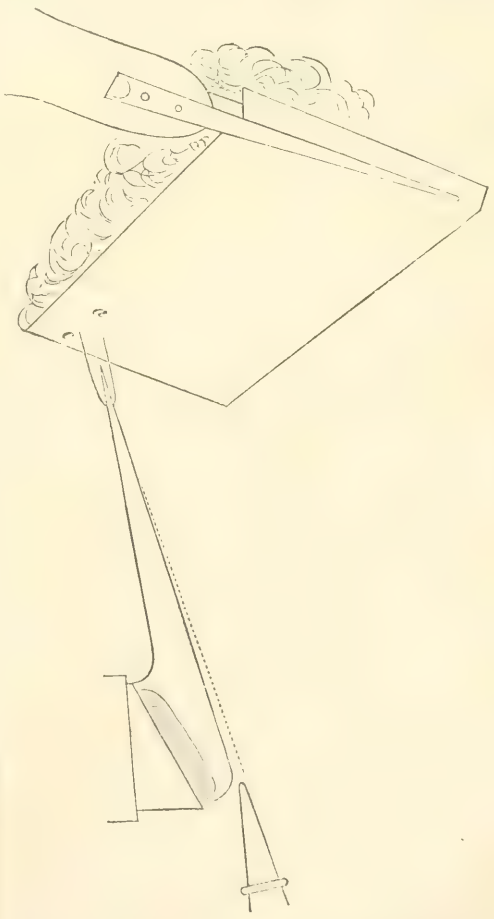


FIG. 7.

ratus, to be found in most chemical works, are manifold and almost amusing. It would be better, if these directions are to be followed, to have no platinum-foil at all

than to have it and not use it; but in practice it will be found that there are comparatively few substances which injure platinum-foil when heated *through* it, to such an extent that it cannot be advantageously used for months. The ore called "stibnite" is one of these, but with care even galena may be thus innocuously roasted.

81. The foil, which should be thicker than the usual English kind, can be conveniently made into a small tray about 1·5 × 1 inch, and held, as in Fig. 7, with a pair of brass pliers having steel legs, the subject of examination being deposited as a paste (made on a slab with distilled water) on its lower lip. The point of the pyrocone must then be applied to the *back* of the tray opposite the substance, and on no account is it to be directed upon its surface.

82. It will be found that only a certain and normal, not an uncertain and irregular, degree of heat *can* thus be applied to substances which under pyrological conditions combine with oxygen or are reduced to the metallic state; and therefore that oxidation on the one hand is as exactly regulated as though it had been controlled by a balance, and that reduction on the other hand need not be feared, except in the case of the very fusible metals, as antimony or lead. For instance, copper pyrites roasted in this way will be found to lose exactly 17 per cent and no more, however long or strongly the pyrocone has been applied.

The same amount of sulphur is thus driven off from "copper glance," and there can therefore be little reasonable doubt that 17 per cent is the extent to which sulphur may be dissipated from copper ores without fusing both together.

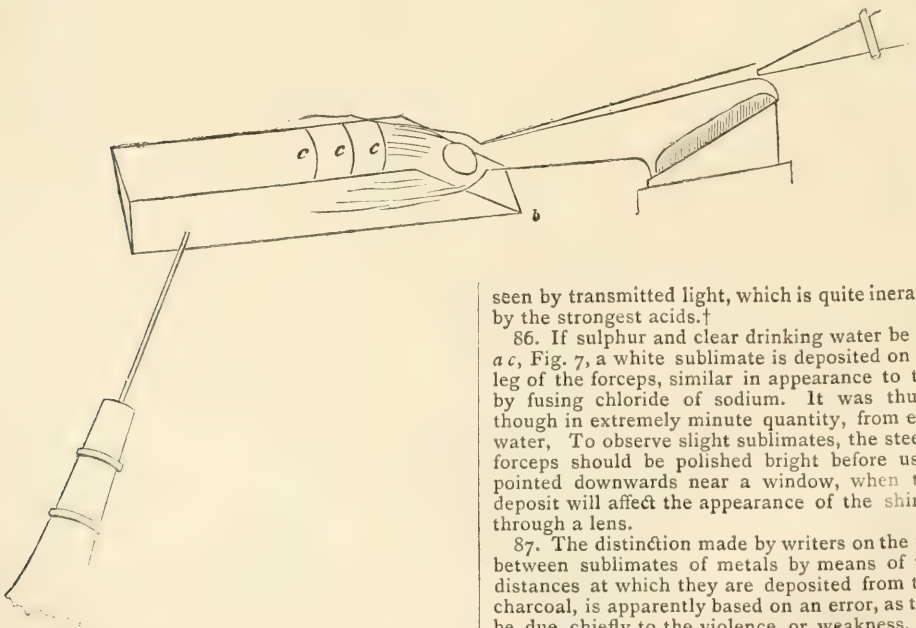
Sublimation.

83. This is better performed on such a platinum tray held by steel-legged forceps than in the ordinary manner on charcoal or in a glass tube. By mixing a little common rust or lime with arsenic or antimony, the most timid operator need not fear injury to his platinum, which, however, it is far better to spoil than to lose a single valuable reaction. The addition of iron sesquioxide has another advantage; for it will be observed that the antimonial oxide mixed with it is deposited on the upper steel leg of the forceps unchanged as a *white* sublimate, but the arsenic oxide as an *orange* one, in consequence, it is presumed, of the ability of the latter to carry up a portion of the red iron oxide with it. This would appear to afford a valuable distinction between these two metals in toxicological cases, which even Marsh's test does not give.

84. If flowers of sulphur be treated in this way, and the upper leg of the forceps be sufficiently high to be out of its blue flame, for of course it ignites, the steel leg will not be found to have changed further than by being covered with a yellow varnish, which is apparently distilled sulphur; but if the leg be plunged warm into water, it will appear white, from the number of bubbles caused by some chemical action upon it. If instead of sulphur only, a mixture of sulphur and any inorganic substance containing nitrogen, as gunpowder (only of course, for this purpose, that must be well watered and ground into a paste), be used, we shall find the forceps apparently unchanged; but after being plunged warm into water, the upper leg will come out perfectly *black*. No bubbles will be observed through the lens, but the leg, on drying, will be found covered with rust.

85. This curious reaction is also produced when sulphur is thus sublimated in company with such minerals as emit an empyreumatic or nauseous odour when heated in a matrass alone, as, *e.g.*, stinkstone. Such minerals, dissolved in a P glass, give also the nitrogenical reaction referred to in paragraph 48; and one of such (a black mineral found at Mussoorie, in India, as hard as topaz, though consisting apparently only of silica, and emitting a smell of burnt fat when heated in a matrass), produced, when dissolved to a supersaturated extent in borax, a fine cerulean-blue bead of extreme hardness.* Both this mineral and gunpowder (the latter alone, the former combined with sulphur) were found, when ground with water in agate mortars, to give them a deep violet tint, best seen by transmitted light, which is quite ineradicable even by the strongest acids.†

Fig. 8.



86. If sulphur and clear drinking water be heated as at *a c*, Fig. 7, a white sublimate is deposited on the polished leg of the forceps, similar in appearance to that afforded by fusing chloride of sodium. It was thus extracted, though in extremely minute quantity, from even distilled water, To observe slight sublimates, the steel legs of the forceps should be polished bright before use, and then pointed downwards near a window, when the slightest deposit will affect the appearance of the shining surface through a lens.

87. The distinction made by writers on the "blowpipe" between sublimates of metals by means of the different distances at which they are deposited from the assay on charcoal, is apparently based on an error, as these seem to be due chiefly to the violence or weakness, as the case may be, of the superposed blast (paragraph 7). This may be proved by causing the sublimate of the *same* metal, as antimony, to be deposited at different distances, as shown at Fig. 8, at *c c c*, through modified blowing.

88. The same figure shows the manner in which it is

* Can the blue colour of the *sapphire* be due to this fact?

† *Nitrate* of silver gives the agate a purplish-black tint.

proposed to utilise the whole effects of the hydrocarbonous pyrocone for substances which cannot be conveniently supported on platinum wire, as metals or alloys, by which the defects of large pieces of charcoal in breaking up and spreading out the pyrocone, and in absorbing and wasting so large an amount of heat, may be avoided. This is by sawing charcoal paste (made of C powder, flour, and water according to the directions given in Plattner's work) into parallelograms about 1½ inches long by ¼ inch deep, and bevelling or slanting off one end as at *b*. This is called a "charcoal mortar," and is supported by a common sewing-needle stuck into one side, as at *a*, Figs. 8 and 10. A cavity is scooped at first in the slanting face of the mortar with the point of a penknife, or, better, an implement like Fig. 9, which is the representation of a broken drift. After some use the mortar burns away as shown in Fig. 10; but no fresh cavity requires to be scooped, as the assay, being hotter than the surrounding paste, burns a place for itself, while the great advantage is obtained by the operator of being able to instantaneously cool and examine the assay at any time, by dipping the whole in a cup of water.

FIG. 9

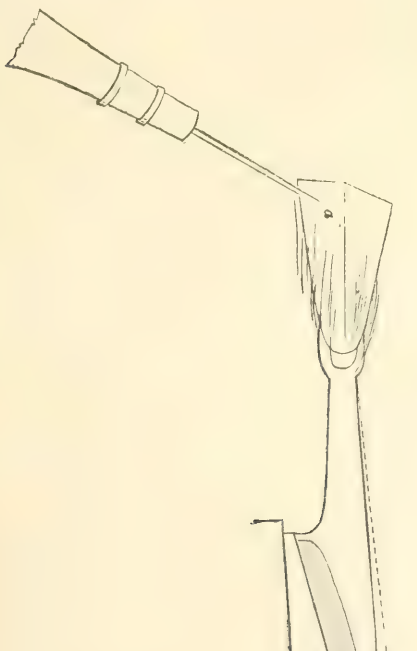


FIG. 10.

Aluminium-Foil as a Support.

89. It has been found that pieces or strips of aluminium-foil, not *under* 3 inches long, withstand the strongest heat of the pyrogene without fusing as well as platinum does, over which the former metal possesses this great advantage, viz., that many metals, as gold, silver, lead, &c., or their alloys, may be fused *upon* it without the least fear of combination. It is thus possible to use this beautiful metal as a support upon which to fuse most other metals, alloys, or metalliferous ores wrapped in a piece of soda-paper, instead of upon charcoal,—the advantages being cleanliness, portability, and even economy, for one strip will last out any number of pieces of charcoal. It is rapidly attacked, however, by chlorides and phosphates.

90. [Minerals heated in P. P. upon Al. foil. afford extremely valuable indications of some oxides, which on charcoal would be fused and reduced, as, *e. g.*, *Kupfer nickel* and *Speisscobalt*, which *thus* immediately yield a fine green oxide—"emerald nickel." (6th August, 1872.)]

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 4th, 1873.

J. P. JOULE, D.C.L., LL.D., F.R.S., &c., President, in the Chair.

"*On a Large Meteor seen on February* 3, 1873, *at* 10 *p.m.*" by Prof. OSBORNE REYNOLDS, M.A.

On the 3rd of February (that is, yesterday), at 10h. 7m. (as afterwards appeared) by my watch (which was 7 minutes fast), I was walking from Manchester along the east side of the Oxford Road (which there runs 30° to the east of south), I had just reached the corner of Grafton-street, when I saw a most brilliant meteor. I first became aware of it from the brightness of the wall on my left, *i. e.*, on the north-east, which caused me to turn my head in that, the wrong, direction; the first effect was that of a flash of lightning, but it continued and increased until it was equal to daylight. On lifting my head I saw directly in front of me, what had previously been hidden by the brim of my hat, a bright object, apparently fixed in the sky, as though it were coming directly towards me; immediately afterwards it turned to the west, and passed just under the moon (which it completely outshone). I was very much startled when I first caught sight of it, owing doubtless to the rapidity with which it was increasing in size and the directness with which it seemed to be coming. The next instant I saw that it was only an extraordinary meteor. It passed the moon, falling at an angle of I should say 20°, and then ceased suddenly, having traversed a path of about 90°, from the south to the east. The colour of the light was that of a blue-light, or rather burning magnesium. The sky was cloudy, but there was no appearance of redness about either the head or the train. I endeavoured to fix its course by the stars, but it was too cloudy, although I could see here and there a star. The conclusions I came to, there and then, were that its course must have been nearly parallel with the road, which by the map runs, at that point, 30° to the west of north; that when I first saw it, it was about 40° above the horizon and due south; and that it passed about 20° to the north of the moon. (This would make its line of approach from Pegasus). While I was thinking of its course I heard a report, not very loud, but which I connected with it. I judged it was about 30 seconds after the display. I then looked at my watch; it was 10h. 7m. I then walked along, talking to a fellow-traveller who had not quite recovered his alarm. Presently we heard a loud report, like a short peal of thunder or the firing of a large cannon. I immediately looked at my watch; it was then 10h. 10m., so that this second report was from three to four minutes after the display. I have no doubt that this was the report of the meteor, for compared with the other it was like the firing of a cannon to a musket. The time of the second report would make the distance 30 or 40 miles, so that it would have passed over Chester and burst over Liverpool. In this case it must have been a tremendous affair, for the sky was cloudy, and I do not

think I exaggerate when I say that at one instant it was as light as day; the train was very long and the speed great. It ceased suddenly, as when a ball from a Roman candle falls into water; there were no fragments, as from an explosion.

"*Note on Meta-Vanadic Acid*," by Dr. B. W. GERLAND. Communicated by Prof. ROSCOE, F.R.S.

A solution of copper vanadiate in aqueous sulphurous acid, after part of the latter is removed by boiling, deposits brilliant yellow crystals, the description and analysis of which I gave in the *Journ. of Pract. Chem.*, 1871, p. 97. These crystals are quite uniform in appearance, and contain cupric oxide, vanadic acid, and sulphurous acid. They rapidly change under the influence of air, their beautiful metallic lustre soon disappears, and the colour becomes a dark green. Although formed in a solution of sulphurous acid, they nevertheless decompose when treated, after separation from their mother liquor, with fresh sulphurous acid, so that two kinds of crystals, brown and orange-yellow, now appear mixed together. An excess of sulphurous acid dissolves the former and leaves the latter intact. After filtration, washing, and drying, they form microscopic scales of beautiful lustre and a deep yellow-orange colour; they are free from copper and sulphur, and perfectly unalterable in the air. Heated to 100° C., and even to 130°, they lose no weight, but at a low red heat water is given off, and the residuum consists of vanadium pentoxide, which fuses and crystallises after cooling.

The composition of the substance, previously dried over vitriol, is, according to analysis, the following:—

Water (loss by heating)	8·73
Vanadium pentoxide	91·06
Impurities	0·21
	100·00

These numbers correspond to the formula of the meta-vanadic acid, VHO_3, which requires—

Water	8·97
Vanadic pentoxide	91·03
	100·00

In some instances I obtained the same bronze or gold-like substance by treating copper vanadiate suspended in water with sulphurous acid gas, and in many others the effect of the gas was formation of vanadic oxide in solution. I intend to elucidate this point by further experiments.

The copper vanadiate was prepared by precipitation of ammonium vanadiate with copper sulphate. The mother-liquor contained both copper and vanadic acid. After evaporation the latter is found in the residue as meta-vanadic acid, with the same metallic appearance as that just described, and can be obtained by washing with water. The crystals obstinately retain copper, sometimes as much as 12 per cent, which is best removed by repeated treatment with aqueous sulphurous acid. A sample of the substance so prepared was analysed by Prof. Roscoe, with the following results:—

Weight of substance taken ..	0·4505 grm.
Loss on ignition	0·0411 „

Hence the percentage composition is found to be—

Water	9·12
Vanadium pentoxide	90·88
	100·00

The samples of vanadium bronze obtained by these three different methods had the same composition, the same appearance, and the same chemical properties. It is essentially distinguished from the amorphous brick-red hydrated vanadic acid by its indifference to reagents. Sulphurous acid scarcely acts on it, neither does ammonia, and even a solution of sodium carbonate dissolves it only after very long-continued boiling. In the air it is perfectly permanent. It is very probable that this meta-vanadic acid will become a favourite bronze, valued even higher than gold.

I trust that at some future time I shall be able to render a more satisfactory account of this interesting substance, and particularly of its formation.

Dr. WILLIAM ROBERTS exhibited some preparations and experiments bearing on the question of biogenesis. He stated that in the last two and half years he had performed over 300 experiments. His results supported the conclusion that the fungi, monads, and bacteria which make their appearance in boiled organic mixtures are not due to spontaneous evolution, but arise exclusively under the influence of pre-existing germs or ferments introduced from without. His method of experimenting consisted chiefly in exposing organic solutions and mixtures to a boiling heat in glass flasks whose necks had been previously tightly plugged with cotton wool. Two modifications of the experiment were adopted:—

I. In the first modification a 4-ounce flask was employed, and the heat applied directly by means of a gas flame.

II. In the second modification—after the introduction of the materials to be operated on—the elongated neck of the flask was sealed hermetically by the blowpipe above the plug of cotton-wool; the flask was then weighted with a collar of lead, and immersed in a large can of water; the can was then put on the fire and the water boiled for 20 or 30 minutes. During the process of boiling, the flask was maintained in an upright or semi-upright position, in order to prevent any wetting of the cotton-wool plug by the contents of the flask. When the can was cold the flask was removed, and its neck filed off above the cotton-wool, so as to permit free ingress and egress of air.

Flasks thus prepared were maintained at a warmth varying from 50° to 90° F. for long periods,—many weeks and months,—some in the dark and some exposed to the light, with the following results:—

I. Simple filtered infusions of animal or vegetable tissues—a very considerable variety were tried—boiled over the flame for five or ten minutes, in flasks previously plugged with cotton-wool, remained permanently barren. This result was absolutely invariable.

II. More complex mixtures—milk, neutralised or alkalised infusions of vegetable and animal tissues, similar albuminous and gelatinous solutions, mixtures containing fragments of animal or vegetable substances or cheese—yielded variable results. In none of them did fungoid growths make their appearance, but monads and bacteria frequently appeared in abundance.

This seemingly contradictory result was inferred to be due to the ineffective application of the heat in the process of direct boiling over a flame. It was found that many of these more complex mixtures frothed excessively when boiled,—*brisk* ebullition could not therefore be maintained,—particles were spurted about on the sides of the flask, and, in this way, apparently escaped effective exposure to the heat. Even when the boiling was prolonged for 20 or 30 minutes the results were still uncertain,—sometimes the flasks remained barren, sometimes they became turbid and swarmed with bacteria.

III. By the second modification of the experiment much more constant results were obtained,—the flasks remained almost always permanently barren,—and the few exceptions were found to be due to some imperfection in the conduct of the experiment. No exceptions occurred with milk, nor with substances, however complex, which were in actual solution; but when considerable pieces of vegetable or animal substances were introduced into the flasks, bacteria and monads with putrefactive changes occasionally made their appearance in abundance. In these exceptional cases, when the experiments were repeated with

the pieces finely comminuted, or introduced in some other way more favourable to the diffusion of the heat, the flasks remained permanently barren.

Dr. Roberts called attention to the crucial significance of experiments on this subject made in flasks whose necks are plugged with cotton-wool. A plug of cotton-wool acts as an absolutely impervious filter to the solid particles of the atmosphere, while it permits a free passage to the gaseous constituents.

When one of these experiments is effectively performed, the fluid or mixture in the flask may be exposed to the full influence of light, of warmth, and of air, and yet it remains permanently barren. As s ow evaporation takes place the liquid passes through al grades of concentration,—possibly chemical changes of various kinds take place within it,—and still no organic growth makes its appearance for months, and even years; but if the plug of cotton-wool be withdrawn for a few minutes, or a single drop of any natural water, however pure and well filtered, be introduced, then all is changed,—in a few days the clear solution becomes turbid from bacteria and monads, or a mass of mildew covers its surface and soon half fills the flask.

In the face of these experiments it was impossible to doubt that the biogenic power of the atmosphere resides in its dust, and not in its gaseous ingredients; but as to the exact nature of that biogenic power—whether it be a specific germ or a ferment—no sufficient evidence has yet been adduced. Dr. Roberts did not find that diminished pressure of the atmosphere, obtained by sealing flasks hermetically in ebullition, after the mode suggested by Dr. Bastian, materially affected the results.

Dr. R. ANGUS SMITH, F.R.S., said that he was glad to see such uniformity of results. His own experiments, which were very numerous on a similar point, were made differently, but were without exception proving the same. As to the name of the substances in the air, he preferred *germ:* it involved no theory. A germ may be considered that which germinates. *Dust* is an equivocal expression which may cause a popular error. *Polarity* introduces a theory which is so entirely without basis that in our present state of knowledge we may call the inference it presupposes decidedly false.

CORRESPONDENCE.

ADULTERATION OF FOOD ACT.

To the Editor of the Chemical News.

SIR,—From your remarks on the Adulteration of Food Act for 1872, you will not be at all surprised when I tell you that I have seen on several occasions men elected as Analysts by Boards of Works who have had to seek tuition from friends of mine before commencing their duties.

I could point to three Medical Officers of Health holding the appointments of Analyst who know nothing whatever of analytical processes.

I have had eight years' practical experience in chemistry, and can prove that out of six parochial appointments for which I have applied four have been given to men who have *no* experience.

If this matter were sifted by the Local Government Board, what a falling off would be there.—I am, &c.,

L. R. C. P.

Feb. 8, 1873.

MISCELLANEOUS.

University of London.—The following Resolution, passed by the Senate on the 12th inst., will take effect at the Matriculation Examination of June next:—That Greek be no longer compulsory on Candidates at the Matriculation Examination, but be ranked as optional with French and German; so that it shall be sufficient for any Candidate to pass in *any one* of these *three* Languages.

Appointment of Analyst.—Dr. Muter, who already holds the appointment of Analyst for the parishes of Lambeth and St. George the Martyr, Southwark, has been appointed by the Wandsworth Board of Works, Analyst for the district.

London International Exhibition, 1873.—The fourth meeting of the Committee on Surgical Instruments and Appliances took place on the 17th inst. at the Royal Commissioners' Offices, Gore Lodge, S.W. The members present were—Mr. Cæsar H. Hawkins, F.R.S., in the chair; Dr. P. Allen; Mr. R. Brudenell Carter; Mr. W. White Cooper; Dr. H. J. Domville, C.B.; Dr. Arthur Farre, F.R.S.; Mr. J. Hilton, F.R.S.; Mr. Liebreich; Mr. J. Lake, F.R.S.; Dr. A. G. Mackay; Mr. J. Marshall, F.R.S.; Mr. T. W. Nunn; Dr. W. S. Playfair; Mr. R. Quain, F.R.S.; and Mr. E. Saunders. The Committee, after transacting the general business of the meeting, considered the applications—more than sixty in number—which had already been received. They adjourned until Monday, the 17th March, the date of receiving the goods being Tuesday, the 11th March next.

Earliest Discovery of Gas-lighting on the Continent.—From a communication published in the *Moniteur Belge*, of the 13th inst., it appears that Pierre-Henri Minkelers, born at Maestricht, December 2, 1748, Professor of Chemistry and Physical Sciences, at Leuven (Louvain) University, from 1772 to 1797, when the University was suppressed—(it was re-established in 1831 as the Catholic University of Belgium),—made a series of experiments, which resulted in the discovery of gas-lighting on October 2, 1784. This is recorded in a small volume, now very rare, a copy of which is preserved in the library at Maestricht, entitled, "Mémoire sur l'Air Inflammable tiré de Différentes Substances," rédigé par M. Minkelers, Professeur de Philosophie au Collége du Faucon, Université de Louvain: Louvain, 1784. After the suppression of the University, Minkelers was, for a series of years, Professor at the Atheneum of Maestricht, where he died July 4, 1824. One of the streets of the city alluded to, viz., that wherein Minkelers resided, has been named after the *savant*. Owing to the political disturbances of the time gas-lighting was not then introduced on the large scale.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, February 10, 1873.

The following original memoirs and papers relating to chemistry are published in this number:—

Specific Gravity of Absolutely Pure Alcohol.—I. Pierre.—Pure vinic alcohol has at 0° a sp. gr. of 0·815, at 15° 0·80214; propylic alcohol at 0° 0·8198, at 15° 0·80825; butylic alcohol at 0° 0·817, at 15° 0·806; amylic alcohol at 0° 0·8253, at 15° 0·8146. The decrease of density at 15° is for—No. 1, 0·01286; No. 2, 0·01055; No. 3, 0·011; No. 4, 0·0107. Respecting the ordinary alcohols and spirits of commerce, the author states that there are no data to judge what influence

mixtures of the three last-named with vinic alcohol will exert upon the sp. gr. thereof.

Annealing of Glass, and more Particularly on the so-called Batavian Glass Drops.—V. de Luynes. This essay records the results of a series of experiments made with the view to ascertain the cause of the sudden breaking of the well-known glass drops, which appears to be due to an unequal annealing of the glass.

Poisonous Properties of the Calcium Salts.—J. Rabuteau and L. Duconday.—A toxicologico-physiological essay, from which it appears that the salts of calcium and potassium are muscular poisons affecting the action of the heart. Incidentally the authors observe that metals are the more poisonous the higher their atomic weight, or the smaller their specific heat.

Researches on the Antiseptic and Therapeutic Properties of Silicate of Soda.—M. Champouillon.—The contents of this paper bear upon the effects of silicate of soda as applied to wounds and pus-secreting surfaces. It would appear that the silicate may become useful as an externally applicable agent.

Chemical Investigation of a Stalagmitic Product from the Solfatara of Pouzzoles.—S. de Luca.—After giving a detailed account of the mode of formation of this stalagmite, the author quotes its percentical chemical composition:—Sulphuric acid (calculated as anhydrous), 20·7: sulphurous acid, 3·6; arsenious acid, 1·5; alumina, 7·9; lime, 6·9; ammonia (NH_4O), 5·3; chlorine, 1·5; protoxide of iron, 1·4; silica, 0·8; water driven off at 100°, 27·8; phosphoric acid, magnesia, potassa, and soda together, 22·7.

Action of Bromine upon Bi-Bromosuccinic Acid; Formation of Tetrabromated Hydruret of Ethylen.—E. Bourgoin.—In the first part of this paper the author records at length the mode of preparation of bi-bromosuccinic acid by treating succinic acid with bromine and water at from 165° to 170° in a strong sealed glass tube. From tetra-bromosuccinic acid, obtained by further bromation of the former compound, the author obtained tetra-bromated ethylen, $C_4H_2Br_4$; a colourless fluid somewhat like chloroform in taste; below 0° this substance crystallises.

Another Aniline Colour.—F. Hamel.—When aniline is treated at the ordinary temperature with chloride of sulphur, there is formed a red-coloured pigment, which is soluble in acetic acid, alcohol, and ether, but water cannot be added to these solutions, as a gray-coloured matter is then precipitated from the solution. The chloride of sulphur should be cautiously added to the aniline, otherwise it becomes carbonised. The red pigment is a solid body, and after evaporation of its solution in alcohol, it is obtained as a deep black-coloured crystalline substance.

Journal für Gasbeleuchtung und Wasserversorgung, No. 24, 1872.

The original papers and memoirs published in this number bear only upon the management of gas- and water-works.

No. 1, 1873.

Contains nothing relating to chemistry.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, January 9, 1873.

The following original papers collaterally relating to chemistry are published in this number:—

Newly-Devised Optical Saccharimeter.—Cornee and Duboscq.—Illustrated with a woodcut.

Gas Retorts.—J. P. Serve.—The description of an improvement in these retorts, whereby a better quality of gas is obtained.

Felted Paper (Japanese Paper).—Pavy, Fisetto, and Co.—The description of a process whereby a paper is obtained which may serve instead of cotton tissues.

Newly-Devised Air-Pump.—V. Garcin.—The account of an arrangement whereby a perfect vacuum is readily obtained.

Bibliography.—Ecole des Chauffeurs: Etude sur les Explosions Fulminantes de Chaudières à Vapeur; Appareil de Sécurité: par M. Testud de Beauregard: Paris, 162, Rue Lafayette. 1 vol. with 5 plates, 3 francs. It appears that this work, the second edition, is mainly intended to instruct stokers of steam-boilers how to manage them, and how to prevent accidents. The work is highly spoken of.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 2 1873.

This number contains the following original papers and essays:—

Alcoholic Fermentation as Induced by Mucor Mucedo.—A. Fitz.—This essay treats exhaustively on the alcoholic fermentation as produced by fungi, and more especially the Mucor Mucedo.

Œnanthylic Acid.—C. Schorlemmer.—The contents of this paper bear upon the rectification of some assertions made by Franchimont in reference to the author's researches on a crude material. It appears, however, that the acid alluded to agrees in many respects with the heptylic acid obtained by the last-named author.

Synthesis of Ketons; Preliminary Communication.—S. Grucarevic and V. Merz.—When chlorbenzol, naphtalin and iron, or zinc are heated together, hydrochloric acid is evolved, and after purifying the substances formed by this reaction, α-naphtyl-phenyl-keton is obtained. It is a crystalline body, fusing at 75°. Other ketons can be prepared by a similar reaction.

Acenaphthen and Naphthalic Acid.—A. Behr and W. A. van Dorp.—Acenaphthen is obtained from coal-tar. It is a solid crystalline body, fusion-point 94° to 94°; yields by oxidation with chromic acid ($K_2Cr_2O_7 + H_2SO_4$ dilute) an acid; formula, $C_{10}H_6O_4$. The calcium salt of this acid yields, by dry distillation with excess of lime, naphthalin; while the acid just mentioned is naphthalin-bicarbonic acid—

$$C_{10}H_6 \begin{cases} COOH \\ COOH \end{cases}$$

A large portion of this paper is devoted to a discussion on the constitution of acenaphthen.

Behaviour of the Chinons when Treated with Soda-Lime.—C. Graebe.

Synthesis of Naphthalin.—B. Aronheim.—These papers, elucidated by a large number of complex formulæ, are, notwithstanding their intrinsic value, not suited for abstraction.

Journal für Praktische Chemie, Nos. 19 and 20 (double number), 1872.

This number contains the following original papers and essays:—

Researches on the Gases Occluded in and Derived from the Pit-Coals of the Saar District.—Dr. E. v. Meyer.—The continuation of this essay, elucidated by a large number of tables.

Estimation of Phosphoric Acid.—C. Schumann.—This monograph is divided into the following sections:—Gravimetrical estimation of phosphoric acid; volumetrical estimation of the same; analysis of native phosphates.

On Sulpho-Carbonic Acid Ether.—Dr. F. Salomon.—This essay contains a large number of complex formulæ; it is divided into the following chapters:—Preparation of carbonyl-oxysulpho-diethyl—

$$CO \begin{cases} SC_2H_5 \\ OC_2H_5 \end{cases}$$

preparation of carbonyl-oxysulpho-diethyl from the Debus-Bender salt; preparation of carbo-sulphuro-dioxy-ethyl—

$$C_5 \begin{cases} OC_2H_5 \\ OC_2H_5 \end{cases}$$

preparation of the carbonyl-disulpho-diethyl—

$$CO \begin{cases} SC_2H_5 \\ SC_2H_5 \end{cases}$$

preparation of carbo-sulphur-oxysulpho-diethyl—

$$CS \begin{cases} OC_2H_5 \\ OC_2H_5 \end{cases}$$

preparation of carbo-sulphuro-disulpho-ethyl—

$$CS \begin{cases} SC_2H_5 \\ SC_2H_5 \end{cases}$$

behaviour of the ethers with caustic potassa and with ammonia; comparative review of the boiling-points; specific gravities of these ethers.

Exponents of Refraction (Optical) of the Sulphuretted Substitution Compounds of the Carbonic Acid Ether.—Dr. E. Wiedemann.

Chemical Review of the Year 1872.—Dr. Kolbe.

Les Mondes, February 13, 1873.

The only original paper contained in this number is:—

Petites Annales de Chimie.—E. J. Maumené.—The eleventh part of this monograph, elucidated by a large number of chemical and algebraical formulæ.

Bulletin de l'Academie Royale des Sciences, des Lettres et de Beaux Arts de Belgique, No. 12, 1872.

No original papers relating to chemistry in this number.

Archives Neerlandaises des Sciences Exactes et Naturelles, No. 5, 1872

In addition to several essays relating to natural history, this number contains the following original memoir bearing upon chemistry:—

Normal Heptylic Acid.—A. P. N. Franchimont.—The paper treats exhaustively on this acid, formula, $C_7H_{14}O_2$, on its salts, and on fatty acids in general. There is being added to this paper a table exhibiting the sp. gr. of the fatty acids at the same temperature.

La Revue Scientifique de la France et de l'Etranger, February 8, 1873.

No original papers relating to chemistry. We call attention, however, to the two following essays:—

History of the French Artillery from the Earliest Periods to the Present Time.—E. Young.—Illustrated with woodcuts.

The Wines of the Pyrenées Orientales.—P. Oliver.—An exhaustive report on the mode of preparation, quality, &c., of wines.

February 15, 1873.

Contains no original papers on chemistry, but attention is called to—

Nutrition of Plants.—E. Morren.—A lecture on this subject.

Annalen der Chemie und Pharmacie, No. 1, vol. clxvi, 1873.

The following original papers and essays are published in this number:—

Acrylic Acid.—J. Wislicenus.—This paper treats on the direct conversion of acrylic into glycerine-iodpropionic acid by first preparing acrylate of sodium, which is next heated to 130° in a sealed glass tube with hydriodic acid. The glycerine-iodpropionic acid thus obtained is a solid body, fusing at from 83° to 84°. By being treated at a higher temperature with oxide of lead, the acid alluded to is again converted into acrylic acid according to the following formula:—$2C_3H_5IO_2+PbO=2C_3H_4O_2+PbI_2+H_2O$.

Isomeric Lactic Acids.—J. Wislicenus.—The main gist of this paper is, that the author has discovered a new modification of lactic acid in meat, different from those now known.

The Conversion-Products of Glycerine-Iodpropionic Acid when Treated with Moist Oxide of Silver. Hydracrylic Acid and its Derivatives (Begleiter) strictly Companions.—J. Wislicenus.—This essay is divided into the following sections:—Hydracrylic acid, $C_3H_6O_3$ and its salts; oxidation of hydracrylic acid; direct conversion of hydracrylic acid into glycerine-iodpropionic acid; acids formed by the action of oxide of silver upon β-iodpropionic acid. Hydracrylic acid is not an aldehyde of glycerine acid; neither is it an ethylen-lactic acid. Hypotheses on the constitution of hydracrylic acid, and thereto allied substances; formula of glycerine acid.

Influence of Inactive Solvents upon the Specific Rotatory Power of Active Substances.—An optico-chemical essay.

Simple Method of Quantitative Estimation of the Quantity of Alcohol Present in Commercial Chloroform.—The process here described is based upon the fact of cinchonine being less soluble in pure chloroform than in a mixture of alcohol and chloroform. This paper is elucidated by tables exhibiting a series of results of experiments when no alcohol is present in the chloroform. The quantity of cinchonine dissolved at 17° is 0·28 per cent, and when 10 per cent of alcohol is present, 4·76 per cent.

Composition of the Essential Oil Contained in the Fruits of Pastinaca Sativa.—J. J. van Renesse.—It appears that the essential oil alluded to is mainly an octylic alcohol, $C_8H_{18}O$, identical with that described by Zincke. The author gives a detailed account of his researches of the derivatives of this alcohol.

Synthesis of Coniine.—H. Schiff.—The second instalment of a monograph on this subject, illustrated by a large number of complicated formulæ.

Action of Sodium Amalgam upon an Alcoholic Solution of Oxalate of Ethyl.—Dr. H. Debus.

American Journal of Pharmacy, February, 1873.

The original papers in this number all relate strictly to pharmaceutical science.

Revue Universelle des Mines, de la Metallurgie, des Travaux Publics, des Sciences et des Arts Appliqués à l'Industrie for July, August, September, and October (one number), 1872.

This number does not contain any original papers relating to chemistry, but attention is called to the following important essays:—

Economy of Fuel by the Application to all Furnaces, Fireplaces, &c., of Gas-Heating, with Complete Combustion and with Constant Volume (sous volume constant).—P. Charpentier, C.E.

Application to Locomotive Engines of Economica Gas-Heating, with Complete Combustion and with Constant Volume.—P. Charpentier, C.E.

Supplement I. des Catalogs von Warmbrunn, Quilitz, und Co.

Under this heading, we have received a pamphlet, illustrated by numerous woodcuts, and containing the detailed description of a large number of apparatus devised by Dr. A. W. Hofmann for lecture experiments.

Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, No. 1, 1873.

The original memoirs published in this number do not strictly relate to chemistry.

Journal de Pharmacie et de Chimie, January, 1873.

This number only contains original papers relating to pharmacy and pharmacognosy.

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C., and 8, Houndgate, Darlington.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

274. R. H. Patterson, Hammersmith, Middlesex, "Improvements in the purification of coal-gas, and in the production of alkaline sulphides to be employed for such purpose."—Petition recorded January 23, 1873.

393. J. McDougall, Manchester, "Improvements in the manufacture of manures."—Petition recorded February 1, 1873.

405. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of essential oils, with a view to their employment as fuel for heating purposes."—A communication from G. Pagliari, Paris.—Petition recorded February 3, 1873.

420. T. W. Dunn and O. Prangley, Trowbridge, Wilts, "Improvements in extracting animal grease and other impurities from wool."—Petition recorded February 5, 1873.

INVENTION PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

474. R. Werdermann, Princes Street, Surrey, "An improved mode of reducing metals from their ores and purifying and refining the same."—Petition recorded February 10, 1873.

NOTICES TO PROCEED.

2889. E. T. Hughes, Chancery Lane, London, "Improved machinery for opening, dividing, and incorporating solid, liquid, and aëriform matters, and also for the evaporation and distillation of fluids, and the acceleration of chemical processes."—A communication from C. J. Schultze, Vienna, Austria.—Petition recorded October 1, 1872.

2913. H. B. Barnett and W. B. M. Slade, Gracechurch Street, London, "Improvements in the preparation or production of disinfecting, antiseptic, and cleansing liquids."—Petition recorded October 3, 1872.

2934. H. B. Barnett and W. B. M. Slade, Gracechurch Street, London, "Improved manufacture of fluids for deodorising and disinfecting purposes."—Petition recorded October 4, 1872.

2974. B. Tanner, Liverpool, "Improvements in the manufacture of artificial manures."—Petition recorded October 9, 1872.

2982. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of alkalies and in apparatus employed therein."—Petition recorded October 10, 1872.

3032. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in treating sulphides, and in obtaining products therefrom."—Petition recorded October 15, 1872.

3052. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in apparatus employed in the manufacture of sulphates of soda and potassa."—Petition recorded October 16, 1872.

3270. C. Rave, Cureghem-lez-Bruxelles, Belgium, "The manufacture from mahogany and other woods of a colouring matter similar to cashoo."—Petition recorded November 4, 1872.

3737. W. R. Lake, Southampton Buildings, London, "An improved method of clarifying and settling varnishes, oils, and other like substances."—A communication from F. Kersting, Grand Rapids Michigan, U.S.A.—Petition recorded December 9, 1872.

3924. W. McAdam, Glasgow, N.B., "Improvements in utilising waste products of chemical and other works, in order to render the same applicable to building and structural purposes."—Petition recorded December 27, 1872.

3970. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "New or improved methods, processes, and apparatus for depositing upon wrought-iron, steel, and cast-iron, layers of copper or alloys of copper."—A communication from O. Gauduin, J. B. J. Mignon, and S. H. Rouart, Paris.—Petition recorded December 31, 1872.

213. G. Haseltine, Southampton Buildings, London, "Improvements in the manufacture of white-lead, and in the purification of carbonic acid gas used in the said manufacture, and in apparatus therefor."—A communication from A. P. Meylert, New Britain, Conn., U.S.A.—Petition recorded January 18, 1873.

273. R. Pitt, Bath, and S. F. Cox, Bristol, "Improvements in the manufacture of leather, and in apparatus for that purpose."—Petition recorded January 23, 1873.

331. B. Latham, Victoria Street, Westminster, "Improvements in purifying sewage, and treating products obtained therefrom for the production of manure."—Petition January 28, 1873.

PATENTS SEALED.

2276. W. B. G. Bennett, Hackney Road, and J. C. Watt, Notting Hill, Middlesex, "Improvements in the preparation of asphalte, and in the application thereof to the construction of roads and foot-paths and other purposes."—Dated July 30, 1872.

2446. A. R. Arrott, Saint Helens, Lancashire, "Improvements in the manufacture of carbonate of soda."—Dated August 16, 1872.

2491. C. F. Sebille, Paris, "Improvements in the composition known as schisto-, asphaltic, and bituminous beton, and novel applications thereof, together with improved machinery or apparatus in connection therewith."—Dated August 22, 1872.

2538. H. Y. D. Scott, C.B., Ealing, Middlesex, "Improvements in the treatment of sewage and in the preparation of manures therefrom."—Dated August 26, 1872.

2617. F. C. Danvers, Ealing, Middlesex, "Improvements in the manufacture of artificial fuel."—Dated September 3, 1872.

MEETINGS FOR THE WEEK.

MONDAY, Feb. 24th.—Medical, 8.
— London Institution, 4.
— Geographical, 8½.
TUESDAY, 25th.—Civil Engineers, 8.
— Royal Institution, 3. Prof. Rutherford, "On Forces and Motions of the Body."
WEDNESDAY, 26th.—Society of Arts, 8.
— Geological, 8.
— London Institution, 7.
THURSDAY, 27th.—Royal, 8½.
— Philosophical Club, 6.
— Royal Institution, 3. Dr. Armstrong, "Formation of Organic Substances."
FRIDAY, 28th.—Royal Institution, 9. General Sir Henry C. Rawlinson, K.C.B., D.C.L., F.R.S., Pres. Roy. Geol. Soc., "On Livingstone's Explorations in Africa."
— Quekett Microscopical Club, 8.
SATURDAY, March 1st.—Royal Institution, 3. Prof. W. K. Clifford, M.A., "On the Philosophy of the Pure Sciences."

TO CORRESPONDENTS.

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THE CHEMICAL NEWS.

Vol. XXVII. No. 692.

ON ANTHRACENAMINE.

By T. L. PHIPSON, Ph.D., F.C.S.

I obtained this new base in the following manner about two years ago, but up to the present time have not completed the investigation.

Anthracen in powder is added in small quantities at a time to ordinary nitric acid contained in a capsule, which can be cooled if necessary. A soft reddish brown mass is obtained, which melts easily, and can be drawn out into long golden-yellow filaments. This product contains a certain quantity of mononitranthracen, $C_{28}H_9NO_4$, soluble in alcohol, from which it crystallises in small yellow needles. If the temperature is allowed to rise, and the acid boils, several other products are obtained, and much oxanthracen. The product is washed and placed in a flask with tin and hydrochloric acid, diluted with its own volume of water, and boiled quietly for half an hour or an hour, then filtered. The filtered liquid contains chloride of anthracenamine and chloride of tin; the base is extracted by excess of potash, which dissolves the oxide of tin and leaves the anthracenamine. It is necessary to repeat the operation twice to get rid of all the tin.

Thus obtained anthracenamine is a pale yellow powder, forming soluble and crystallisable salts with sulphuric and hydrochloric acids. It is very soluble in alcohol, and water precipitates it from this solution; it is slightly soluble in water; it has only a slight odour, but its taste is hot, pungent, and persistent, very like that of a substance yet unknown which exists in the leaves of the *Arum maculatum*. Its acid salts even when much diluted produce, with a few grains of bichromate of potash, a characteristic emerald-green colour, and finally precipitate a powder of this colour, which is soluble in alcohol. This solution presents no marked peculiarity when viewed in the spectroscope. The reaction is as characteristic of anthracenamine as the blue colour produced in similar circumstances is of naphthalamine. It is not obtained, however, with peroxide of lead, nor with hypochlorite of lime, which appears to produce an oily, brown-coloured chloro compound, but it is obtained with concentrated nitric acid.

From the percentage of nitrogen found in anthracenamine I conclude that its composition may be represented as $C_{28}H_{11}N$. When oxidised by chromic acid (bichromate of potash) it is changed into a new base.

Similar to naphthalamine and its salts, anthracenamine and its compounds are rather easily decomposed. In treating by hydrochloric acid the green oil extracted by pressure from crude anthrancen, I have also obtained a base having properties and composition very similar, if not identical, with those of anthracenamine.

Laboratory of Analytical Chemistry, Putney, S.W.

ON A NEW LOCALITY OF AMBLYGONITE, AND ON MONTEBRASITE, A NEW HYDRATED ALUMINIUM AND LITHIUM PHOSPHATE.*

By M. DES CLOIZEAUX.

A mineral found in 1862, at Hebron, Maine, U.S.A., after a mere tentative examination by Prof. Brush, who announced the presence in it of lithia in considerable quantity, resembled the amblygonite of Penig so closely as to lead to its being looked on as amblygonite. The crystalline system and birefringent optical characters of this mineral were determined by the author in 1863. In 1870 a mineral found in the tin vein of Montebras (Creuse), though resembling the amblygonite of Hebron, appeared to the author to differ from it so far as to justify his designation of it under the name of Montebrasite. Towards the close of 1871 he received another specimen from Montebras, which presented all the characters of the American amblygonite, and which consequently was easily distinguished from the montebrasite. Subsequently, analyses by Pisani, v. Kobell, and Rammelsberg, and optical observations by the author, proved the identity of the montebrasite of Montebras with the amblygonite from Penig. But this is not the case with the amblygonite from Hebron, nor with that from Montebras, which had been analysed by Pisani. These differ from the amblygonites of Saxony and Montebras (which last he had previously named montebrasite) by the absence of soda, by the preponderance of lithia, and the presence of a notable amount of water, while at the same time they contain almost equal proportions of phosphoric acid and alumina.

The differences which these two minerals present in their physical and chemical characters are sufficiently decided to compel our treating them as distinct species. The name amblygonite should be retained for the sodolithic species first discovered at Penig by Breithaupt, and the white or violet-tinted lamellar masses abundant at Montebras will be included under it; the hydrated and entirely lithic species comprising the laminar specimens and the crystals from Maine, as well as some greenish masses from Montebras, would be embraced under the name montebrasite.

The amblygonite of Montebras has only been met with in laminar masses with a faint tinge of violet. These masses exhibit two cleavages presenting nearly the same degree of facility, making with one another an angle of 105° 44′. Close observation shows that the sharpness of the reflected images is generally a little greater on one of the cleavages than on the other, and this induces one to suppose that they do not both belong to equivalent crystallographic planes. The study of some of their optical properties, though presenting certain special difficulties, arising from the small extent of the transparent portions, and the presence of numerous twin plates, even in the specimens that to all appearance are the most homogeneous, has proved that the laminar masses of montebrasite must be referred to the triclinic system. The optic axes are situated in a plane which divides into two very unequal parts the acute angle of 74° 16′ of the two cleavages. This direction is entirely different from that found for montebrasite of Hebron and of Montebras, in which the plane of the axes lies in the obtuse angle of 105° formed by the two principal cleavages.

The appearance of the bars traversing the central ring of each system indicates very distinctly a twisted dispersion, as well as a small amount of inclined dispersion, which is characteristic of a crystal belonging to the triclinic system.

In November, 1871, the author received a specimen from the middle of a mass of amblygonite, from Montebras, resembling the mineral from Hebron. It has three principal cleavages, p, m, t, which the author recognised in the mass from Hebron, the angles between which are $p\,m$ = 105°, $m\,t$ = 135 to 136, $p\,t$ = 89 to 89° 15′.

By means of artificial twins formed of two plates, each of which had been worked perpendicular to the two cleavages p and m, and which were united by their faces p, it appeared that the plane of the optic axes is situated in the obtuse angle $p\,m$, and traverses the edge $\frac{p}{m}$, but that it is not quite normal to m, since it gives angles of about 82° with m and 23° with p. The character of the coloured rings shows that in montebrasite of Montebras, as in that from Hebron, there coexists with the horizontal

* Abstract of a paper read before the Royal Society.

a well-marked inclined dispersion; and these are peculiar to crystals of the triclinic system.

Analyses by M. Pisani.

	Hebron.	Montebras.
Fluorine	5·22	3·80
Phosphoric acid	46·65	47·15
Alumina	36·00	36·90
Lithia	9·75	9·84
Water	4·20	4·75
	101·82	102·44
Specific gravity	3·03, Pisani.	3·01, Pisani.
" "	2·99, Damour.	2·977, Damour.

Wavellite in the form of thin coatings forms a layer over almost all the fissures that occur in the amblygonite of Montebras. In cavities in these coatings are found long thin needles, which have enabled the author to correct the older measurements of this mineral.

M. Pisani has ascertained that the variety from Montebras yields—

Fluorine	2·27
Phosphoric acid	34·30
Alumina	38·25
Water	26·60
	101·42
Specific gravity	2·33

EXAMINATION OF FLAVINE, WITH REMARKS ON THE PROCESSES OF LEESHING AND SCHLUMBERGER FOR PRODUCING DYES FROM QUERCITRON.

By ADOLPH OTT, New York.

The flavine handed to me for examination came from the Stamford Manufacturing Company, 157, Maiden Lane, New York. It represented a light, fallow powder, but sparingly soluble in hot water, and separating again on cooling. The supernatant liquid remained slightly coloured. Warm alcohol, even when diluted, dissolved it quickly,—not so ether. Tartrate of potassa and copper was not reduced by an aqueous solution, showing the absence of sugar. The solution remained clear on adding a solution of glue, thus indicating the absence of tannin. Sodium amalgam, when added to an alcoholic, slightly acidulated solution, gave rise to the well-known purple reaction indicative of quercetin: this reaction was, by the way, also obtained with the deposit of a decoction of yellow bark. The watery solution of flavine decoloured permanganate of potassa, proving the presence of gallic acid. (Test of Monier.) The absence of tannin and the presence of gallic acid was to be considered as proof that the alkaline decoction of the bark had been treated for some time with sulphuric acid.

The above-mentioned tests satisfied me that the sample was a remarkably pure flavine.

The late Professor Bolley, who first made us acquainted with the method of manufacture of flavine, discovered tannin and sugar in flavine analysed by him. My specimen was free from both, but contained gallic acid, the derivate of tannic acid. Since a solution of crude quercitrin assumes a beautiful yellow colour when protochloride of tin is added, this being not the case with my flavine, I drew the conclusion that it was free from quercitrin. This fact was also to be inferred from the presence of gallic acid.

Prompted by the results of this investigation, I began to search whether there existed other analyses of flavine besides that given by Bolley. My researches in this direction remained without result, but I obtained, on the other hand, some notes which strikingly illustrate how slow industries sometimes progress when they are unaided by science. According to James Napier, who published a book on the art of dyeing in 1853, the flavine must have become a commercial commodity in or about the year 1850. Aside from describing its behaviour towards mordants and vegetable fibres, the author states that it contains 4·4 per cent ashes. They consisted doubtless of sulphate of soda. Supposing that the dye-stuff had not been washed out, and that to make the decoction the same quantity of water had been employed as prescribed in the patent specification of Leeshing, it would be very easy to calculate how much soda was used. The quantity was doubtless very large. In 1856 ("Repertory of Patent Inventions") Leeshing, in Glasgow, secured a patent for the treatment of yellow bark, weld (the herb of *Reseda luteola*), and flavine, for the purpose of enhancing their colouring power. He terms "quercitrin" the material obtained from quercitron; "flavetin," the one obtained from flavine. His first process consists in boiling the pigment-yielding substance either with dilute sulphuric or hydrochloric acid, and then washing it out with cold water; a second process consists in previously boiling the dye-woods or dye-stuffs in a weak soda solution, saturating with sulphuric or hydrochloric acid, and boiling for half an hour. The inventor claims that the products thus obtained differ from the original substances in being free from tannin and lime (!), and in having acquired new properties, viz., a greater affinity for mordants and a more vivid and richer colour. Being less soluble in water, they are preferable for the dyeing of such tissues as require a boiling heat in the vat.

Since particular stress is laid upon the increase of the intensity of the colour, it is to be assumed that the flavine contained then a larger proportion of quercitrin. Although the patentee fails to give hints with regard to this point, my supposition has been confirmed by the results of an examination of flavine imported in 1853 into Germany, made by Kœnig. I am unfortunately not in possession of the original paper, yet, according to Gmelin, Kœnig obtained quercitrin in minute crystals by treating the flavine with very dilute boiling sulphuric acid, and by purifying the separated flocculent precipitate,—the ordinary manner.

However, it will always remain a disputed point whether Leeshing was or was not acquainted with the papers on quercitrin by Rigand, who first communicated the fact that this substance is split up if acted upon by dilute mineral acid. This paper appeared in the *Chemical Gazette*, two years previous to the date of Leeshing's patent. I would remark that Rigand was well aware of the fact that mordanted cotton assumes a purer yellow when dyed with quercetin than when dyed with quercitrin.

With regard to the process of Leeshing for enhancing the colouring power of the yellow oak, Bolley, in his "Chemische Technologie der Spinnfasern," says that it was not rational, the quercetin formed being deposited on the bark. But the learned technologist failed to consider that the process in question was also applied to flavine, which was already then a commercial commodity, and, moreover, we may well accept that it was not the intention of Leeshing to extract the colouring matter, partly because the weighty bark with enhanced colouring power brought a proportionally higher price than the pure dye-stuff, and partly because the demand for the latter (the flavine) was undoubtedly not yet sufficiently large. When considered in this light the inventor certainly deserves credit. One of the processes is quite analogous to the preparation of garancine from madder. In both cases a substance combined with glucose must be set free, to be converted into a dye-stuff. In short, the "quercitrin" of Leeshing is a technical product from quercitron.

After the beautiful researches of Bolley and Rigand on quercitrin had already been published, it is incomprehensible that Muspratt (*vide* his "Chemistry Applied to the Arts and Manufactures," ed. of 1860), in treating of the above-mentioned dyes, states that their intensity was

probably enhanced because the colouring matter had become more soluble in water. Yet on the very same page, in giving an abstract of the patent specification of Leeshing, he mentions that the derivates in question, upon being treated with hot as well as cold water, yield *much less* colouring matter than the materials from which they had been produced.

Schlumberger, according to Grothe, treats the bark of the yellow oak as follows:—100 kilos. of the ground wood are mixed with 280 litres of water, acidulated with 25 kilos. of oil of vitriol. This mixture is boiled for two hours, whereupon the bark is washed out, pressed, and dried. For the same quantity of bark Schlumberger takes four times the quantity of acid (of only one-third the strength) of that of Leeshing, but extends the time of treatment to twice the length. These are the only points in which these two methods differ from each other. In speaking of this process, Grothe, in his "Katechismus der Bleicherei, Färberei, und des Zeugdrucks" (p. 103), remarks:—"All the tannin having been separated by treating the bark with sulphuric acid, the colours produced with *quercetin** are much purer and brighter than those obtained with flavine." I am at a loss to comprehend this, for it must be evident to every one that the ground bark, when directly treated with acids, must always contain a larger amount of intermediary products than flavine, even when this latter has not been properly washed out. Grothe, moreover, observes:—"Dye-extracts from quercitron, which contain mainly quercitrin, yield with alum a beautiful yellow," I ask, how is it possible that extracts from quercitron, among which Grothe includes the flavine, dye a beautiful yellow, if yet containing tannin, which, according to Grothe, act injuriously? And, why have extracts of quercitron been produced "with a high percentage of quercitrin," since "recent investigations have demonstrated that they contain quercetin which is principally effective?"

Immediately after this, Grothe remarks:—"For this reason the quercetin is now especially made." If Grothe designates with this name the prepared bark of Schlumberger, he will excuse me for asking why it is that it is not preferable to produce the flavine, which, with regard to purity and intensity of colour, is to the yellow bark as the purpurine of Kopp to the madder of Alsace?

With regard to the behaviour of the peculiar kind of tannic acid contained in the bark of *Quercus tinctoria* many erroneous views seem still to exist. Bolley, in his above-mentioned treatise, observes, for instance, that it was probable that the flavine furnishes a purer yellow than the bark of quercitron, because it has been freed from the greater part of tannic acid. It appears to me that it would have been more correct to state that the flavine produces a purer colour because it consists chiefly of quercetin, as Bolley himself has demonstrated, while the bark contains only the less colouring quercitrin. It is, moreover, not quite clear to me in what manner the tannic acid referred to could act injuriously, since, for dyeing yellow, the goods are not mordanted with iron salts. Besides, the tannic acid from quercitron, according to Schlossberger, yields green, not black, when coming in contact with salts of peroxide of iron. This was already known by Dr. Bancroft when he wrote, in his patent specification, bearing date of 1775:—"This species of bark may be distinguished from all others by its giving with alum a fine yellow colour, and not striking a black upon the addition of iron."

According to Grothe ("Katechismus" &c., p. 103) flavine yields a dark, greenish-black precipitate with salts of protoxide of iron, and citron-yellow with salts of protoxide of tin. This can be comprehended only when it is known that Grothe compiled from the above-mentioned book of Napier, who evidently examined a kind of flavine containing much tannic acid. With salts of protoxide of iron, pure flavine yields a green colour with olive tint; with tin salt the liquid only assumes a brighter colour. A decoction of bark, however, from which quercitrin has already separated, produces, with salts of protoxide of iron, a greenish black; with tin salt, a light yellowish precipitate. In this latter case the supernatant liquor grows reddish.

In dyeing with a decoction of the bark, the brown colour discovered by Chevreul acts undoubtedly more injuriously than tannin does.

If therefore one chooses, with Bolley, to ascribe the purer yellow of the flavine to the absence of a foreign substance, it would certainly be more correct to seek the cause of this fact in the absence of the brown colour of Chevreul. Every dyer knows that in dyeing with the bark of quercitron high temperatures are not desirable, the brown dye being then absorbed by the fibre, just as in dyeing with aniline violet the red colour contained therein is withdrawn at a high degree of heat.—*American Chemist.*

* Schlumberger thus designates his product.

ON THE

CONSTITUTION OF ALCOHOLS,

AS A MEANS FOR THE

IDENTIFICATION OF "RADICALS" IN ORGANIC COMPOUNDS.

By S. E. PHILLIPS.

IF glycerine and the sugars be alcoholic, then their relations from that point of view should be consistently estimated.

If alcohol by a certain reaction gives sulphovinic acid, and glycerine alcohol in the same way gives sulphoglyceric acid ($C_4H_5O.HO+2SO_3$ and $(C_6H_7O_4)O,HO+2SO_3$), then it is just possible that all alcohols may manifest one type and be monatomic.

An extended digest of the new views lies before me, which might be tedious to recapitulate in this connection, but it may be well to give a brief view of the monatomic aspect which would have resulted, by applying new facts to the older views, and it does appear that a larger measure of simplicity, and general consistency attends this aspect.

Just as the oxidation of alcohol gives acetic acid, so, precisely, the oxidation of glycol and glycerine alcohols gives glycolic and glyceric acids—

			Acid.
Alcohol,	C_4H_5O	$+HO+4O=$	Acetic, $HO+(C_4H_3O_2)O$ and $2HO$
Glycol,	$(C_4H_5O_2)O$	$+HO+4O=$	Glycolic, $HO+(C_4H_3O_4)O$ and $2HO$
Glycerine,	$(C_6H_7O_4)O$	$+HO+4O=$	Glyceric, $HO+(C_6H_5O_6)O$ and $2HO$

And all these, by similar generic reactions, give their corresponding amides. Thus, from the alcohols we derive—

Ethylamine, $(C_4H_5)H_2,N$
Glycolamine, $(C_4H_5O_2)H_2,N$
Glyceramine, $(C_6H_7O_4)H_2,N$

And many other substitutional forms, where these radicals replace H in similar ways. From the acids we derive—

Acetamide, $(C_4H_3O_2)H_2,N$
Glycolamide, $(C_4H_3O_4)H_2,N$
Glyceramide, $(C_6H_5O_6)H_2,N$

And many other substitutional forms.

Among the infinite display of varied ammonias, M. Wurtz has synthetically produced one of much interest, which is proved to be identical with *neurine* from the brain, and *choline* from the liver; it is a chloride of ammonium, with the 4 equivs. of H replaced by 3 atoms of ethyl and 1 atom of glycyl (or the radical of glycol), E_3G,NCl, and from this saltic body other variations may be produced, as the hydrate and chloroplatinate, &c.—

$E_3GNO+HO$
$E_3GNCl+PtCl_2$

M. Wurtz notates its derivation thus—

$$\underbrace{(C_2H_5)_3N}_{\text{Tri-ethylamine.}} + \underbrace{C_2H_4\begin{cases}OH\\Cl\end{cases}}_{\text{Chlorhydrate of Glycol.}} = \left.\begin{matrix}C_2H_4OH\\C_2H_5\end{matrix}\right\}NCl.$$

It is said the action of HCl upon glycol does not correspond with its action upon common alcohol, for, instead of yielding a chloride of ethylene, it gives a compound of hydrochloric acid with oxide of ethylene. This is a notable instance of the way in which plain facts can be distorted by pre-conceived hypothesis; I would rather say that HCl acts upon glycol precisely as it does upon alcohol—

Alcohol, $C_4H_5O + HO$ and HCl = chloride of ethyl .. .. } C_4H_5, Cl and 2HO

Glycol, $C_4H_5O_2,O + HO$ and HCl = chloride of glycyl .. .. } $C_4H_5O_2$, Cl and 2HO

Glycerine, $C_6H_7O_4,O + HO$ and HCl = chloride of glyceryl .. .. } $C_6H_7O_4$, Cl and 2HO

It is said that glycolic acid is the first member of its series, standing in the same relation to the glycols as acetic acid does to ordinary alcohols. To these relations I see no objection, but, as acetic acid is not the first of its series; so neither is glycolic. Formic acid—

$$HO + C_2H_1O_2O,$$

leads of one series, as formolactic, $HO + C_2H_1O_4,O$, does in the other.

It is further stated that as the glycolic series is intermediate between the acetic and oxalic series, so there are three alcohol series with glycol as the intermediate—

Acetic acid,	$C_4H_4O_4$	Vinic alcohol,	$C_4H_6O_2$
Propionic acid,	$C_6H_6O_4$	Propyl alcohol,	$C_6H_8O_2$
Glycolic acid,	$C_4H_4O_6$	Glycol,	$C_4H_6O_4$
Lactic acid,	$C_6H_6O_6$	Propyl glycol,	$C_6H_8O_4$
Oxalic acid,	$C_4H_2O_8$	Glycerine,	$C_6H_8O_6$
Malonic acid,	$C_6H_4O_8$	Propyl glycerine,	$C_8H_{10}O_6$

But with the two atoms of oxalic acid the harmony is destroyed. The alcohols are, it is said, mono-, bi-, and tri-atomic, but of the acids it is alleged they are mono- and bi-atomic only.

As *one atom* of oxalic acid is monatomic like the other two series, this discrepancy seems to throw some doubt on the tri-atomicity of the others. Again, what possible connection is there with the oxalic series? If there be any merit in this play upon comparative or parallel series, the way out of this confusion and dilemma is indeed plain and easy, but it leads adversely to another monatomic series.

The acetates are fairly collated with the alcohols, because so derived; the glycerates with the glycols, because similarly derived; and, pray, why not the glycerates with the glycerine alcohols, as equally due to the same process of derivation?

Alcohols, $C_4H_6O_2$ Glycols, $C_4H_6O_4$ Glycerines, $C_6H_8O_6$
Acetates, $C_4H_4O_4$ Glycolates, $C_4H_4O_8$ Glycerates, $C_6H_6O_8$

It is important to observe in this connection that all these three classes of acids are admittedly mono-atomic.

It is deemed *very remarkable* that the boiling-points and specific gravities of the glycols decrease as their complexities increase; but it is evidently quite natural that it should be so, as a glance at the diminishing relative quantities of the denser constituent, O, might fairly pre-indicate—

Propyl glycol, $C_6H_8O_4$; sp. gr., 1·051; boils at 371° F.
Amyl glycol, $C_{12}H_{12}O_4$; sp. gr., 0·987; boils at 351° F.

The binoxide and bichloride of ethylene, so-called, form an interesting study; they may be aldehydic, $C_4H_3O_2,H$ and $C_4H_3Cl_2,H$, but the former has two isomeric forms, one boiling at 56° F., the other at 68°, and one is probably that of a weak alcohol, $C_4H_3,O + HO$. It is very questionable whether either of them fulfils the definite combining function assumed in modern chemistry.

Thus far all is plain: the analogies are consistent, and it remains to be seen whether the many other alcohol derivatives will bear out this generic comparison.

Modern researches in regard to ethyl and acetyl substitutions appeared to throw a flood of light on the wide question of alcoholic type, and, while working with much interest in these fertile developments, I encountered a check in the counter-statement of Prof. Wanklyn, but, upon reconsideration, it may turn out that the Professor, while doing excellent work in re-calling old facts which had been lost sight of, and confirming them by new researches of a refined and valuable character, has yet been too sweeping in his inferences and deductions therefrom; to wit, that all the recent speculations on ethyl substitutions are in error, and that his is the only view which can be entertained, &c. ("British Association Report," 1868, p. 48). On the contrary, it is now mooted that the general facts of ethyl and acetyl substitutions taking place with evolution of H, atom for atom, are not invalidated by the fact that in many cases this evolution is not apparent, the displaced atoms in the nascent condition entering other forms of combination; though it is freely admitted that the statements made by Frankland and Duppa in regard to the free evolution of H by action of sodium on acetic ether may be in error.

Prof. Wanklyn's equation is thus—

$$\underbrace{3\left\{\begin{matrix}C_2H_3O\\C_2H_5\end{matrix}\right\}O}_{\text{Acetic Ether.}} + 4Na = \underbrace{3\left\{\begin{matrix}Na\\C_2H_5\end{matrix}\right\}O}_{\text{Ethylate of Sodium.}} \text{ and } \underbrace{\begin{matrix}Na\\(C_2H_3O)_3\end{matrix}}_{\text{Sodium Tri-acetyl.}}$$

It is further said "the resulting compound may be viewed in different lights, we may represent the sodium as tri-atomic, thus—

$$(C_2H_3O)_3Na'''$$

or thus—

$$\left.\begin{matrix}C_2H_3O\\C_2H_3\end{matrix}\right\}\left.\begin{matrix}\\\\O\\\\\end{matrix}\right\}\left.\begin{matrix}O\\\\\\\\\end{matrix}\right\}\left.\begin{matrix}C_2H_3\\C_2H_3\\Na\end{matrix}\right\}$$

This drawing is curious in its way, and I hope to have rendered it correctly; but the hydride is more simply notated—

$$\left.\begin{matrix}C_2H_3O\\C_2H_3O\\C_2H_3O\\H\end{matrix}\right\}$$

It is not said, however, whether the H, as replacing the sodium, is also tri-atomic.

The sodium compound is called sodium tri-acetyl; by Frankland and Duppa, ethylic sodacetone carbonate; by Geuthier, æthylen-dimethylen-carbonsaure-natron. Assuming that this body does result from the action of sodium upon acetic ether under certain conditions of temperature and confinement, and that, by varying the conditions, a varied reaction would result, we then have to enquire as to the exclusive alternative involved.

We are at liberty to accept or not the ingenious type arrangement, or the Geuthier nomenclature, but there is no other way of explaining the fact of hydrogen's non-evolution than the tri-atomic theory presented.

Upon old views, however, the difficulty is by no means so imperative—

$$\underbrace{3EO + AcO}_{\text{Acetic Ether.}} + 4Na = \underbrace{C_{12}H_9O_6,Na}_{\text{New Body.}} \text{ and } \underbrace{3NaO + EO}_{\text{Ethylate of Sodium.}}$$

There is nothing at all abnormal in this arrangement, and the hydride as an oily liquid, &c., may well be compared with similar analogues and probably homologues; this much, however, is said in deference to the description given of the compound as a hydride, otherwise I should prefer to regard it as a diacetic alcohol—

$$HO + C_{12}H_9O \text{ and } KO + C_{12}H_9O, \text{ where } C_{12}H_9 =$$
$$= \left\{\begin{matrix}C_4H_3\\C_4H_3O_2\\C_4H_3O_2\end{matrix}\right\}O + HO,$$

or 2 of acetyl replacing 2 of H in the ethyl radical.

The production of this body is in all probability very analogous to that of the acetines, stearines, triacetic celluloses, &c., all being produced by the same character of reaction, by heating the mixtures in sealed tubes under pressure; they all reproduce the original alcohol, from which they are derived by a reaction with alkalies, and all the nitro-substitutions are more or less explosive.

Heated in a tube under pressure, the following mixtures give as follows:—

Alcohol	and acetic acid	=ethyl-acetine, *Wanklyn's hydride*
Glycerine	and acetic acid	=glycer-acetine
Glycerine	and stearic acid	=glycer-stearine, *Stearine*
Glycerine	and nitric acid	=glycer-nitrine, *Nitro-glycerine*
Cellulose	and nitric acid	=cellulose-nitrine, *Gun-cotton*
Cellulose	and acetic acid	=cellulose-acetine
Glucose	and acetic acid	=gluco-acetine
Phenol	and nitric acid	=phenol-nitrine, *Picric acid*
	&c.,	&c.,

and as each of these acids and many others may substitutionally enter all the alcohols, so, conversely, each alcohol may combine with, or substitutionally take into its type, any of the multifarious acid radicals; hence we have here a new horizon of endless fertility, and this feeble glance may, peradventure, be a foretaste of reward and encouragement for my effort to enhance the value and importance of the generic aspects of modern chemistry (see CHEMICAL NEWS, vol. xx., p. 49).

We have looked far and wide to discover any traces of diatomic or triatomic peculiarity in these varied substitutions, and find no indication whatever.

Whether we digest with an alcohol, acetic, or succinic acid, an orcin, or a chinon; both reaction and result appear in a generic sense strictly identical; indeed the very simplest expression of the wide formula would be—

$$\text{Alcohol} + \text{alcohol} - 2\text{HO} = \text{di-alcohol}$$
$$C_4H_6O_2 + C_4H_6O_2 - 2\text{HO} = C_8H_{10}O_2$$

the alcohol being $(C_4H_5)O+HO$, the dialcohol—

$$\begin{array}{l} C_4H_4O+HO \\ C_4H_5 \\ \hline C_8H_9O+HO \end{array}$$

In like manner—

$$\text{Saligene} + \text{sugar} - 2\text{HO} = \text{salicine}, C_{26}H_{18}O_{14}$$

And M. Schiff, perhaps the very highest authority in this field, regards it as an alcohol; then—

$$\text{Hydrochinon} + \text{sugar} - 2\text{HO} = \text{arbutine}, C_{24}H_{16}O_{14}$$

The radical of the chinon replaces 1H in the sugar; hence—

$$(C_{12}H_5O_2)O + HO + (C_{12}H_{11}O_{10})O + HO - 2\text{HO} = (C_{12}H_{10}O_{10})O + HO$$

$$\begin{array}{l} C_{12}H_5\ O_2 \\ \hline \end{array}$$

$$\text{Arbutine} = (C_{24}H_{15}O_{12})O + HO$$

As the radical of acetic acid, $(C_4H_4O_4)$, is admittedly $(C_4H_3O_2)$, is, then, the radical of diatomic hydrochinon $(C_{12}H_5O_2)$, and that of saligene $(C_{14}H_7O_2)$, and that of glucose $(C_{12}H_{11}O_{10})$, or that of arbutine $(C_{26}H_{15}O_{12})$?

The very great presumption in favour of the affirmative can only be made approximatively certain by an appeal to such varied derivatives as those referred to in the onset of this paper in regard to ethyl, glycyl, and glyceryl.

In the meantime I regard it as almost certain that the varied amines or amides of these radicals are, or can be, obtained, and as we get sulpho-vinic or sulpho-glyceric, so we get sulpho-saccharic acid—

$$HO,SO_3 + (C_{12}H_{11}O_{10})O,SO_3;$$

and M. Schiff has, with distinguished ability, supplied the materials whereby we may extend the wide formula so as to include the ammonias, and say further that sugar or an alcohol + ammonia − 2HO = a gluco-ammonia or similar body, where the radical of the sugar or other analogue substitutes 1H in the ammonia.

Hence it is that, eschewing the modern notations of M. Schiff, we find that—

$$\left.\begin{array}{l}\text{Sugar + aniline} - 2\text{HO} - \text{glucos-} \\ \text{anilide} \end{array}\right\} (C_{12}H_5)(C_{12}H_{11}O_{10})H,N$$

$$\left.\begin{array}{l}\text{Helicin + aniline} - 2\text{HO} = \text{heli-} \\ \text{cin-anilide} \end{array}\right\} (C_{12}H_5)(C_{26}H_{15}O_{12})H,N$$

$$\left.\begin{array}{l}\text{Helicin + toluidine} - 2\text{HO} = \\ = \text{helicin-toluidide} \end{array}\right\} (C_{14}H_7)(C_{26}H_{15}O_{12})H,N$$

$$\left.\begin{array}{l}\text{Aceto-helicin + toluidine} - \\ - 2\text{HO} = \text{aceto-toluidide} \end{array}\right\} (C_{14}H_7)(C_{42}H_{23}O_{20})H,N$$

In such cases, it is evident that the radical of the sugar, or glucoside, replaces 1H in the type ammonia.

$$\left.\begin{array}{l}\text{Salicylous acid + sugar} - 2\text{HO} = \\ = \text{helicin} \end{array}\right\} (C_{26}H_{15}O_{12})O + HO$$

$$\left.\begin{array}{l}4\text{ acetic acid + helicin} - 8\text{HO} = \\ \text{tetraceto-helicin} \end{array}\right\} H(C_{42}H_{23}O_{20})O + HO$$

Or—

$$\begin{array}{l} C_{26}H_{11}O_{12},O+HO \\ (C_4\ H_3\ O_2) \\ (C_4\ H_3\ O_2) \\ (C_4\ H_3\ O_2) \\ (C_4\ H_3\ O_2) \\ \hline C_{42}H_{23}O_{20},O+HO \end{array}$$

$$\left.\begin{array}{l}\text{Gallic acid + gallic acid} - 2\text{HO} = \text{tannic} \\ \text{acid} \end{array}\right\} \begin{array}{l} C_{14}H_4O_8,O+HO \\ C_{14}H_5O_8 \\ \hline C_{28}H_9O_{16},O+HO \end{array}$$

$$3\text{ gallic acid} + \text{sugar} - 6\text{HO} = \text{tannin} = C_{54}H_{22}O_{34}.$$

I have notated this as a glucosan, because, if it be a glucoside, the formula of its genesis is abnormal; but I do not by any means insist on its being a glucosan, as there are other means of abnormality in compounds so complex.

Referring to M. Schiff's tannic acid as a di-gallic, I think M. Wurtz has misinterpreted the true character of these alleged dedoublements. He urges that the radicals of polyatomic acids may accumulate in one, and the same constitution, united together by the intervention of atoms of oxygen, &c., &c., and his notations of di-ethylen-alcohol-diglycolic acid, di-lactic acid, di-tartaric and lacto-succinic acids, all imply two entire radicals in the combination.

On the contrary, I regard these as varied illustrations of the wide formula under consideration, and would appeal to their ammoniacal or other derivative forms as affording a crucial and valid test of their real atomic structure. Moreover, it is apparently immaterial whether the condensation or ingestion be produced by monatomic or by the so-called polyatomic acids.

$$\left.\begin{array}{l}\text{Glycollic acid + glycollic acid} - 2\text{HO} = \\ = \text{di-glycollic} \end{array}\right\} \begin{array}{l} C_4H_2O_4,O+HO \\ C_4H_3O_4 \\ \hline C_8H_5O_8,O+HO \end{array}$$

$$\left.\begin{array}{l}\text{Lactic acid + lactic acid} - 2\text{HO} = \text{di-} \\ \text{lactic acid} \\ \text{\&c.,} \qquad \text{\&c.} \end{array}\right\} C_{12}H_9O_8,O+HO$$

In the lichen sugars we have—

$$\left.\begin{array}{l}\text{Orsellinic acid + erythrite} - 2\text{HO} = \\ = \text{picro-erythrin} \end{array}\right\} C_{24}H_{15}O_{12},O+HO$$

$$\left.\begin{array}{l}2\text{ Benzoic acid + erythrite} - 4\text{HO} = \\ = \text{benzo-erythrin} \end{array}\right\} C_{36}H_{17}O_{10},O+HO$$

$$\left.\begin{array}{l}\text{Orsellinic acid + orsellinic acid} - \\ - 2\text{HO} = \text{alpha-O-erythrin} \\ \text{\&c.,} \qquad \text{\&c.} \end{array}\right\} C_{32}H_{13}O_{12},O+HO$$

With very limited means of research, I can merely point out the prominent points in this wide and fertile region; but I cannot conclude this incipient sketch without an emphatic reiteration in regard to the use here made of the alcoholic type. We do not presume to pronounce whether an alcohol be a hydrate $(C_4H_5,O+HO)$ or a hydride $(C_4H_5O_2),H$.

If we could by any means get an omniscient glance at

these atomic arrangements, the probability is it would be neither, but following the representative forms initiated by Liebig and others in the discovery of organic radicals; we simply contend that, whatever arrangement subsists in regard to the structure and reactions or dedoublements of methylic alcohol, that the same in principle equally subsists in ordinary and other alcohols, &c.

Among the glucosides we have—

Saligine + glucose − 2HO = salicine	$C_{26}H_{18}O_{14}$
(?) + glucose − 2HO = populine	$C_{42}H_{22}O_{16}$
Quercitrine + glucose − 2HO = quercitrin	$C_{38}H_{18}O_{20}$
Frangulinic acid + glucose − 2HO = frangulin	$C_{40}H_{20}O_{20}$
Chiococcin + glucose − 2HO = caincin	$C_{48}H_{38}O_{20}$
Salicylous acid + glucose − 2HO = helicin	$C_{26}H_{16}O_{14}$
2 Benzoic acid + helicin − 4HO = benzo-helicin	$C_{40}H_{20}O_{16}$
(?) + glucose − 2HO = digitalin	$C_{56}H_{48}O_{28}$
Ploretic acid + phloro-glucin − 2HO = ploretin	$C_{30}H_{14}O_{10}$
Ploretin + glucose − 2HO = phloridzin	$C_{42}H_{24}O_{20}$
2 (?) + glucose − 4HO = bryonin	$C_{96}H_{80}O_{38}$
Hydrochinon + glucose − 2HO = arbutin	$C_{24}H_{16}O_{14}$
(?) + 4 glucose − 8HO = ericolin	$C_{68}H_{56}O_{42}$
(?) + 2 glucose − 4HO = pinipicrin	$C_{44}H_{36}O_{22}$
(?) + 2 glucose − 4HO = daphnin	$C_{62}H_{34}O_{38}$
3 Gallic acid + glucose − 6HO = tannin	$C_{54}H_{22}O_{34}$
Esculetine + glucose − 2HO = esculin	$C_{30}H_{16}O_{18}$
4 Acetic acid + glucose − 8HO = gluco-acetic acid	$C_{28}H_{20}O_{20}$
4 tartaric acid + glucose − 8HO = gluco-tartaric acid	$C_{28}H_{16}O_{28}$

Fraxin, rhamnegin, and datiscin do not exactly correspond with the generic formula of production.

This occasions no surprise or hesitation; the wonder is that, with such complex materials, and projected without any recognition of the law of their genesis, that such abnormal cases are so few; and it demands that the very highest mead of praise should be awarded to the skilful workers in detail who have elaborated such wonderful results.

At the onset I had included esculin among this small minority, but, thanks to M. Schiff, it is now conformable, and further confirmed by an aceto-esculin.

6 acetic acid + esculin − 12HO = aceto-esculin	$C_{54}H_{28}O_{30}$! !

Of course it will be understood that any of these radicals can now be identified from the preceding notations.

Just as the radical of acetic acid, $C_4H_4O_4$, is $(C_4H_3O_2)O+HO$, so that of tetraceto-esculin, $C_{46}H_{24}O_{26}$, is $(C_{46}H_{23}O_{24})O+HO$; and such it is actually found when replacing 1H in aniline—$(C_{46}H_{23}O_{24})(C_{12}H_5)HN$.

Parallel with the above list we have a corresponding series with glucosan ($C_{12}H_{10}O_{10}$) instead of glucose ($C_{12}H_{12}O_{12}$), and here, also, the aceto-benzo-butyric and ethylic glucosanides conform strictly in every case yet collated with the formula.

Then we have a tabular collocation of glycerides and glycides, with mono-, bi-, tetra-, and hexa-substitutions—

Alcohol + glycerine − 2HO = ethylin	$C_{10}H_{12}O_6$
2 Alcohol + glycerine − 4HO = di-ethylin	$C_{14}H_{16}O_6$
3 Alcohol + glycerine − 6HO = tri-ethylin	$C_{18}H_{20}O_6$
2 Succinic acid + glycerine − 4HO = succinin	$C_{14}H_{10}O_{10}$
2 Acetic acid + glycerine − 4HO = acetin	$C_{14}H_{12}O_{10}$
2 Tartaric acid + glycerine − 4HO = glycer-tartaric acid	$C_{14}H_{10}O_{14}$

I merely give a few typical instances, and it is worthy of remark that the alleged diatomics behave in a way quite conformable with alcohol or acetic acid.

There are other complex tartaric substitutions which do not apparently conform to this law of genesis, but such is also the case with ethyl-derivatives; nevertheless there are peculiarities connected with some so-called diatomic acids, and these well deserve a careful study and estimation apart from all preconceived hypothesis.

We have long and deeply entertained this problem, and trust to have made some progress towards its elucidation, but the subject is very wide, and permeates the entire fabric of chemical philosophy.

The power of prediction is a valid test of true theory, and I am content to leave this matter with two inferences, which may easily be tested by any chemist who may be working with the materials involved.

(1). Hofmann gives us glycerine, or glycyl-alcohol	$C_6\ H_8\ O_6$
Di-glycyl-alcohol	$C_{12}H_{12}O_8$
Tri-glycyl-alcohol	$C_{18}H_{20}O_{14}$

On the contrary, by the application of the preceding principles, the law of genesis requires that di-glycyl-alcohol (so-called) should be $C_{12}H_{14}O_{10}$, and that such, it will be found, admits of no doubt whatever.

(2). Hofmann, in comparing a triplet of compounds, notates them all as bibasic.

1. Ethyl-bilactic ether	$\left.\begin{matrix}(C_3H_4O)''_2\\ HE\end{matrix}\right\}O_3$
2. Bi-ethyl-lacto-succinic ether	$\left.\begin{matrix}(C_3H_4O)''\\ (C_4H_4O_2)''\\ EE\end{matrix}\right\}O_3$
3. Bi-ethyl-trilactic ether	$\left.\begin{matrix}(C_3H_4O)'''_3\\ EE\end{matrix}\right\}O_4$

On the contrary, by the law of their genesis it becomes plain that the first and third are really monatomic, while the second has three atoms in the basic part.

The first is misnamed: it should be bilactic ether, and the radical of the acid is as thus $(C_{12}H_9O_8)O+EO$.

The third is correctly named: omitting the "bi," it might very plausibly be a tri-lactic acid with 2 atoms of base, and, guided by the notation, I at first so considered it; but it is not such—it is an ethyl-trilactic acid with 1 atom of ether base, or $C_{22}H_{17}O_{12},O+EO$.

The second is misnamed: it is not an ethyl-lactic-succinic acid, but a lacto-succinic acid, with 2 atoms of ether and 1 of HO as base; or, as lacto-succinic acid is in all probability $C_{14}H_7O_8,O+3HO$, so the above would be $C_{14}H_7O_8,O+2EO,HO$.

Referring to the first case, the ultimate explanation is not difficult to foresee. Glycerine + glycerin − 2HO = = di-glycerine − pyro-glycerine, or di-glycyl-alcohol. A higher temperature or more protracted digestion under pressure would give 2 glycerine + glycerine − 4HO = = triglycerine. Whence, then, comes the body spoken of, and called the di-alcohol, or $C_{12}H_{12}O_8$?

As glucose has its glucosan, mannite its mannitan, alcohol its aldehyde, so glycerine has its corresponding glycide; and if atomic proportions of glycerine and glycide be heated in a sealed tube for some time, a generic condensation will take place, the result being—

Glycide + glycerine − 2HO = glycide-glycerine = $C_{12}H_{12}O_8$.

Any or all of these points may easily be proved. I lay less stress upon the lacto-succinic acid than upon the others, involving as it does a wide class of considerations only incidentally referred to in the previous pages and still under investigation.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 20th, 1873.

Professor Frankland, D.C.L., F.R.S., President, in the Chair.

The minutes of the previous meeting having been read and confirmed, Messrs. W. Koch, F. J. Hicks, and Miles H. Smith were formally admitted Members of the society. The following names were then read for the first time—Messrs. Andrew F. Crosse, Thomas Fulcher Best, W. Ram-

say, James William Bantock, and Frederick Douglas Brown. For the third time—Messrs. Waldron Shapleigh, Edward Dillon, B.A., John Perry, George Browurn, Thomas Williams Sheppard, John Carrington Sellars, and Herbert Y. Loram, who were then ballotted for and duly elected.

This being the meeting appointed by the bye-laws for announcing the proposed changes in the Council and officers of the society, the President stated that Dr. Odling had been proposed as the new President, and that the Senior Secretary, Mr. Vernon Harcourt, having announced his intention of retiring from the office, Dr. Russell had been proposed to succeed him. The Vice-Presidents would be Dr. Voelcker, Dr. Roscoe, and Mr. Vernon Harcourt, in place of Drs. Noad, Odling, and Russell; and the other Members of Council, Messrs. Duppa, Divers, M. Foster, Spence, and Armstrong, in place of Messrs. Bassett, Field, Roscoe, Voelcker, and Angus Smith.

Mr. T. WILLS then read a paper on the "*Solidification of Nitrous Oxide*." The author, after briefly sketching the history of the liquefaction of nitrous oxide, proceeded to describe the processes and apparatus with which he had succeeded in obtaining it in a solid state by the evaporation of the liquid. Although the apparatus which he had described was generally the most convenient, the liquid nitrous oxide quickly solidifies if a rapid current of air be passed through it. Unlike carbonic acid, the liquefied gas can readily be preserved for some length of time in an open vessel, provided it be kept still. Liquid carbonic acid becomes solid immediately it is allowed to escape from the vessel containing it, since the vapour tension of the carbonic snow at the time of its formation is much above the atmospheric pressure, whilst liquid nitrous oxide boils at $-92°$ C., and solidifies at $-99°$, so that the vapour tension of the solid is less than one atmosphere. The density of the liquid at 0° is 0·9004, and like liquid carbonic acid it is very expansible and immiscible with water. The author exhibited the formation of the solid nitrous oxide, and performed several experiments with the liquefied gas.

The PRESIDENT, after observing that the Members were much indebted to the author for showing them solid nitrous oxide in such large quantities, said that there were several points which it would be very desirable to investigate in relation to the liquid, such as its rate of expansion between different temperatures, and it was to be hoped that Mr. Wills, who had had so much experience with the liquefied gas, would furnish the society with some further communication on the subject at a future time.

Mr. WALENN said that in 1870 he had made some experiments with the gas, and had succeeded in liquefying considerable quantities in an iron vessel somewhat similar to that exhibited. On inverting it, and opening the stop-cock, liquid nitrous oxide came out, and a small quantity of a snow-white substance formed on the side of the vessel in which the liquid was received.

The next paper, "*On Aurin*," by R. S. DALE, B.A., and C. SCHORLEMMER, F.R.S., was read by the SECRETARY. The substance, prepared by treating phenol with oxalic acid and sulphuric acid, and known in commerce by the names of *aurin*, *yellow corallin*, or *rosolic acid*, is a brittle resinous body with beetle-green lustre. To purify it, alcoholic ammonia is added to a cold alcoholic solution of aurin, and the resulting crystalline precipitate of the ammonia compound is decomposed by boiling it with dilute acid, and re-crystallisation from acetic acid. It forms needles or prisms, having a brilliant lustre and of the colour of chromic acid, which retain both water and acetic acid most obstinately; in a similar manner, when crystallised from hot concentrated hydrochloric acid, it retains hydrochloric acid, even after being heated to 110°. Aurin dissolves in alkaline solutions with a red colour, and is re-precipitated on the addition of an acid; it does not melt below 220°. When sulphur dioxide is passed into a hot concentrated alcoholic solution of aurin, and the mixture allowed to cool, a compound of sulphur dioxide and aurin separates in red crystals with green lustre. These appear to contain 1 molecule of sulphur dioxide united with 2 of aurin. Compounds of aurin with potassic bisulphate, ammonic bisulphate, and sodic bisulphate, were also obtained. Leucaurin, $C_{21}H_{18}O_3$ or $C_{20}H_{16}O_3$, which is prepared by the action of zinc-dust on an alkaline solution of aurin, crystallises from its solution in acetic acid in thick prisms. By treatment with acetyl or benzoyl chloride, three atoms of hydrogen are replaced, and *triacetyl-leucaurin* or *tribenzoyl-leucaurin* are obtained, both of which are crystalline. The authors have also prepared aurin from pure phenol, and find that it does not retain water in the same way as that obtained from the commercial product. By analysis it gave the formula $C_{20}H_{14}O_3$, whilst the formula $C_{21}H_{16}O_3$ agrees best with that prepared from the commercial product. The authors have commenced the investigation of "peonine" and "azuline," two colouring matters obtained from aurin by the action of ammonia and aniline respectively.

Dr. FRANKLAND said he felt certain the Members would agree with him in returning thanks to the authors for their researches on this important colouring matter, whose constitution was obviously complex. The results obtained were not always so sharp as investigators might wish, but it would appear that the authors had definitely settled that the leuco-body contained three semi-molecules of hydroxyl, and there was no evidence against aurin itself containing them.

In reply to a question from the President, Dr. H. MULLER said that the dye was principally used for paper-staining in the form of a lime-lake with excess of lime; it was then a stable colour.

A paper, entitled "*Researches on the Action of the Copper-Zinc Couple on Organic Bodies: I. On Iodide of Ethyl*," by Dr. J. H. GLADSTONE and A. TRIBE, was then read by the former. The couple employed in the author's experiments was prepared by treating zinc-foil with a dilute solution containing about 1 per cent of cupric sulphate. It thus acquires a black colour from deposition of copper, and is ready for use after being washed and dried. On heating the couple to 100° with ethylic iodide, a gas is given off in small quantity, and ethiodide of zinc formed, which, when gently heated, is resolved into zinc ethyl and zinc iodide. Zinc alone, or zinc etched with sulphuric acid, has scarcely any action on iodide of ethyl at 100°. When the couple acts on iodide of ethyl in the presence of water, a gas is freely given off at the ordinary temperature, which, on examination, proved to be hydride of ethyl. With alcohol the action is somewhat slower, but the gas produced is the same. In the latter case a gummy residue is left in the flask, which, from its properties and composition, the authors believe to be iodethylate of zinc. They hope soon to communicate to the society the results of the action of the couple on the homologues of iodide of ethyl.

The PRESIDENT remarked that not only this society, but chemists in general, must feel grateful to the authors for their method of preparing zinc ethyl, a substance which had now become almost as necessary a reagent in the laboratory as alcohol or ether. There was always a great loss in the old way of operating in closed vessels at a high temperature, and although various improvements had been suggested, such as the employment of zinc etched with acids, and the use of an alloy of sodium and zinc, they had been found not to answer. Even when the zinc and sodium alloy was used with the addition of zincic ethide to the ethylic iodide, the operation was very slow, requiring a long time, whilst with the zinc-copper couple the operation was complete in an hour; moreover, by working at a comparatively low temperature, the loss from the formation of ethylic hydride and ethylene was avoided, and the proportion of zinc ethyl obtained was comparatively large.

Mr. WALENN suggested the employment of the metals separated, as the compound formed in contact with the

zinc-copper plate must diminish the action. Perhaps it would be better to employ zinc and platinised platinum, and to introduce a galvanometer into the circuit, so as to observe the changes which took place. He would like to ask Dr. Gladstone whether he had made any experiments with separated couples.

The President said that the low conducting-power of the liquid would probably interfere, a remark confirmed by Dr. Gladstone.

Dr. Russell asked if the authors had examined the black deposit for zinc, as from experiments he had made he should be inclined to believe that it was a sort of alloy of copper and zinc, the product obtained with very dilute solutions of cupric sulphate containing more zinc than with strong ones.

Dr. Muller remarked that the same thing took place in reducing chloride of silver, the reduced silver containing zinc, and evolving hydrogen when treated with hydrochloric acid.

Dr. Gladstone said he was glad his attention had been drawn to this subject, and, as the copper deposited from very weak solutions acted most powerfully, it was possibly from the cause suggested by Dr. Russell.

The last paper, by Mr. A. H. Smee, jun., "*On the Detection of Ammonia in the Atmosphere*," was read by the author. The apparatus employed consists of a glass funnel drawn out to a point, and filled with ice, so that the moisture from the atmosphere, condensed on the outer surface, together with the ammonia and volatile organic matter, can be easily collected. The author has examined the aqueous vapour condensed by this apparatus in various situations, in the country, in a garden in Finsbury Circus, in stables, ferneries, the wards of hospitals, and near the river at Westminster, making determinations of the amount of ammonia present, and also microscopical observations of the crystalline forms left on evaporating the liquid. The paper was illustrated by numerous and carefully-made drawings of these microscopic crystals.

The President thanked the author for his communication, and especially for the interesting microscopical observations; those made in the wards of hospitals might perhaps throw some light on zymotic diseases. He would also like to know whether he had understood the author to say that he had found 0·22 part of ammonia per gallon in the rain-water collected at Carshalton, as the samples collected for him by Dr. Gilbert, at Rothamstead, only contained about 0·02 per gallon.

In reply to a question put by Dr. Attfield, as to whether the same diseases always gave the same microscopic forms, the author said it was very difficult to get isolated cases of any particular disease, as they were generally mixed up together.

The meeting then adjourned until Thursday, March 6, when the following papers will be read:—"On the Action of Hydrochloric Acid on Codeine," by Dr. C. R. A. Wright. "New Processes for Mercury Estimation, with some Observations on Mercury Salts," by P. Hannay. "On a Method of Estimating Nitric Acid," by T. E. Thorpe. "Note on the Action of Acetates upon Solutions of Plumbic Salts, with Remarks upon the Solubility of Plumbic Chloride," by F. Field.

CORRESPONDENCE.

ANALYSIS OF ANIMAL CHARCOAL.

To the Editor of the Chemical News.

Sir,—Having to analyse a considerable number of samples of animal charcoal for carbon, I used the ordinary calcination process. The samples were dried at 350° F., calcined until perfectly white, moistened with carbonate of ammonium, again gently heated, and the loss put down as carbon. A complaint being made that the carbon was too high, I tried the method given by Fresenius, consisting in the removal of soluble matters in hydrochloric acid, throwing on a weighed filter, washing, drying at 212° F., and igniting. On the same sample the first method gave 12·28 per cent, the second method 8·20 per cent.

The same sample analysed in Glasgow was tested between 8 to 9 per cent, I could not get the exact figures. In this case what is the duty of the chemist? Here are two methods, both found in modern books, and giving results differing by 4 per cent. Without entering into the question of what is the cause of this difference, I shall be glad if you will use your influence to bring about a uniform method of testing, so that, at all events, comparative results may be obtained.—I am, &c.,

F.C.S.

February 19, 1873.

DR. MORFIT'S TREATISE ON "MINERAL PHOSPHATES AND PURE FERTILISERS."

To the Editor of the Chemical News.

Sir,—In the Chemical News, vol. xxvii., p. 73, there is an adverse criticism, by Mr. E. Esilman, of certain portions of my recent work, which challenges a reply that I am pleased to be able to give as follows:—

1. In reference to my process B (page 238), which prescribes the use of the alumino-ferruginous pulp as precipitant of hydrochloric solutions of mineral phosphates, it had its inception after the book was written, and its completion only when the manuscript was half through the press. Indeed, it was an after suggestion of the process A (p. 227), which represents my successful efforts to use lime as a precipitant, so as to throw down the phosphate of lime constituent as Colombian phosphate, wholly or nearly free from iron and aluminum associates.

On this account, and because I had become broken down by feeble health, analyses of the products of my experiments were not ready to be appended to the recorded description, and details of the steps by which they were obtained; nor have I yet precised by further essays whether the precipitation was due to one or more constituents of the pulp. Moreover, I saw, in experimenting with the limited quantity of only ten pounds of raw mineral at each operation, that it was almost impossible to adjust the ratio of pulp so as to prevent an excess of the latter, and therefore considered the samples as unjust to the process. But most of the precipitates thus obtained have been since analysed by my direction, and here are the results from two average samples:—

Components.	Precipitate from Navaza Guano.	Precipitate from South Carolina Phosphates.
Water, accidental	12·14	22·74
Ditto constitutional	14·32	9·38
Silicia, sand, &c.	0·37	1·24
Sulphate of lime (?)	1·26	
Aluminum and iron compounds	14·12	6·83
Lime	23·93	31·77
Magnesia	0·63	0·26
Phosphoric acid	33·55	28·80
Total	100·32	101·02

2. Practically it is immaterial which of the constituents of the pulp may effect the precipitation. If it is the aluminous constituent, then the pulp may be used as it is. On the other hand, if it should be the iron constituent, then it will be only necessary to dissolve out the alumina by means of soda. The aluminate of soda thus incidentally formed is a product which will yield a large profit upon the cost of production.

3. The advantages to accrue from the use of the alumino-ferruginous pulp as precipitant are very obvious and manifold. In the first instance it yields as a by-product, and without cost, a mother-liquor, which is a strong solution of aluminum and iron compounds, containing only that

portion of lime which existed in the raw mineral as carbonate. This liquor is therefore in itself a ready and economical substitute for the specially prepared solutions of the Redonda and Alta Vela guanos employed in the defecation of sewage.

In the second place, it forms an inexpensive source of raw material most admirably adapted, by its pulpy nature and sensitiveness to chemical action, for the manufacture of alum and other aluminum compounds of industrial value.

Thirdly, the production of this mother-liquor in the manner of the process B, affords the means of recovering the original hydrochloric acid indefinitely, by merely evaporating the liquor to dryness in vessels which may act as stills. This latter is a most important consideration in those localities where mineral phosphates abound naturally, and there is a want of a cheap supply of hydrochloric acid. Moreover, the iron and alumina are thus reclaimed also for further utilisation.

4. The precipitation of the phosphate of lime constituent as Colombian phosphate—that is, as a mixture of di- and tri-phosphate, will insure a beautiful product, so chemically sensitive to the influences of the soil, so prompt, potent, and economical as a fertiliser, that it is superior even to the bi-phosphate. It will thus in time render obsolete the use of the latter; and, as a consequence, the production of sulphuric acid will decline, and the manufacturers of fertilisers will have to abandon their old processes for the public benefit. But these are trade considerations which should have no influence whatever with the chemist in his pursuit of scientific improvements. Even though the precipitated phosphate may contain some iron and aluminum compounds, through careless manipulation, the latter will not debase the quality of the former for direct application to the soil.

5. As to the lime or process A, the results of Mr. Esilman's experiments are even more surprising and mysterious to me than those obtained by him in the previous case, and therefore it is not in my power to explain his error. I have only to say for myself, that in following out faithfully the instructions set forth at pages 227 to 238 of my book, I obtained repeatedly, from different kinds of raw mineral, very good precipitates, as the following analyses will show:—

Components.	Precipitate from Calais Coprolites.	Precipitate from South Carolina Phosphate.
Water, accidental	16·60	12·33
Ditto constitutional	6·81	8·60
Silica and sand..	0·03	1·54
Sulphate of lime (?)..	3·00	5·19
Iron and aluminum compounds	6·01	2·04
Lime	33·23	34·34
Magnesia	0·60	0·55
Phosphoric acid	31·74	32·77
Total	98·02	97·36

This process, by reason of the manner in which it controls the action of the lime as precipitant, and imparts superior characteristics to the precipitate, assumes an importance scarcely less than that of the preceding method, B, just discussed. It has the advantage of requiring less time for its practical operation. It is true that the mother-water from the precipitation by lime will contain more chloride of calcium than that of the B process; but, nevertheless, it retains all the iron and aluminum compounds of the original mineral, and is still suitable therefore, though in a somewhat lesser degree, for defecating sewage; and will yield all its alumino-ferruginous burden as a pulpy precipitate upon the addition of milk of lime in the usual manner.

The only objection to this process, apart from the equally unimportant one of diluting the mother-water with chloride of calcium, is, that it will not allow the reclamation of more than a portion of the hydrochloric acid of the mother-liquor, and then only with greater labour and expense than is required in the previous process.

The water in the products above analysed can be dried out if required.

6. It is, of course, necessary to adjust the proportion of lime precisely to that of the phosphate of lime constituent of the raw mineral, in order to prevent some iron aluminum compounds going down with the precipitate, and at the same time to insure the entire separation of the lime phosphate from the mother-liquor. But this is a manipulation which will grow more and more perfect with time and experience.

7. In respect of my formulæ for chemical analysis, I am well conscious that they are not perfect; but being founded upon my best experience and judgment, I will let them remain for what they are worth, until I see better lights upon the subject than are now open to me. They are, indeed, at fault as to the way of distinguishing the phosphoric acid belonging to lime, from that which pertains to the iron and aluminum constituents of the raw mineral; but chemical science is to blame in this particular, as she has yet to advance to a solution of this problem. By my prescription some portion of the phosphoric acid belonging to the lime is thrown down with the aluminum and iron oxides which may be present. And I record this portion in my table of analytical results as combined with iron and alumina, though it may, in fact, belong largely to lime. Many other chemists report the total phosphoric acid as equivalent to phosphate of lime. Thus, while the latter distinguish in favour of a class, I give the benefit of the doubt to the general public.

In conclusion, my treatise is the pioneer book of its subject, and a work of great labour conscientiously performed, whatever may be its shortcomings. I have endeavoured to present every point in its most improved relations to science and art, according to my best judgment. The competitive processes of other chemists are recorded impartially side by side with my own; and when better information than I possessed on any one point was accessible I quoted it from the proper sources, as in the instances of Spence's and Townsend's methods for treating mineral phosphates of alumina. Failing positive knowledge from any source on incidental matters, I have presumed to give my own ideas for the practical solution of them. It is possible that some of my suggestions for reclaiming certain "wastes" may not be strictly economical for England; but my book is not written for any one region, and there are other countries of different productive and commercial relations where my precepts may fall into suitable soil. Mr. Esilman must excuse me, therefore, if I persist in believing that I pursued the best plan in the construction of my work, even though it has touched, inharmoniously, his professional sensibilities, and stirred within him a carping spirit of criticism.—I am, &c.,

CAMPBELL MORFIT.

Southport, February 21, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, February 17, 1873.

In addition to a series of original papers relating to astronomy, mathematics, meteorology, natural history, and physiology, this number contains the following original memoirs;—

Presence of a Large Quantity of Saltpetre in the Amarantus Blitum.—A. Boutin.—The contents of this phytologico-chemical essay record the results of some experiments, from which the author draws the conclusion that this wild-growing plant, which contains as much as 10 to 12 per cent of nitrate of potassa, draws the nitrogen from the atmosphere, converting that element, by the process of vegetation, into nitrate of potassa. The author further states that this plant may be utilised as a living saltpetre manufacture, as well as for manuring vines, &c. The soil on which the plant grew was never manured at all.

Action of Fuming Nitric Acid upon Aceto-chlorhydrose.—A. Colley.—By the reaction of fuming nitric acid upon aceto-chlorhydrose, there is formed acetonitrose, a beautifully crystalline compound, insoluble in water, soluble in alcohol and ether, fuses at 145°, sp. gr. 1·3487. Boiling water converts this compound into a substance which reduces the tarto-cupropotassic liquor. The author states that the new body is tetraceto-mononitro, $C_6H_7O(C_2H_3O_2)_4NO_3$.

On Atractylic Acid.—M. Lefranc.—In the first portion of this paper the author enters into theoretical discussions on the place which this acid should hold in organic chemistry, it being his opinion that the acid is a conjugated acid, which by saponification behaves as the ether of divalero-sulphuric acid; the result being that there is formed a new body, atractyline; a gum-like amorphous substance, soluble in water and alcohol, insoluble in ether, formula $C_{40}H_{30}O_{12}$.

Researches on the Oxidising Power of the Blood.—P. Schützenberger and C. Risler.—The record of the results of a series of experiments made with blood—some saturated with oxygen, some freed from it entirely—and hydrosulphite of soda. It would appear that the oxygen is not present in the free state, but chemically combined in blood.

Researches on the Influence of the Variations of the Barometric Pressure upon the Phenomena of Life.—P. Bert.—A very important physico-physiological memoir.

Les Mondes, February 20, 1873.

Reorganisation of the Observatory of Paris.—By decree of the President of the French Republic the observatory alluded to has been entirely reorganised. Le Verrier has been appointed director, and the following *savants* constitute the council:—Belgrand, Inspector-General of the Ponts et Chaussées: Vice-Admiral Jurien de la Gravière; Fizeau; Janssen; Tresca; Daubrée; Y. von Villarceau; Wolf; Gaillot-Ray; Marié-Davy has been appointed director of the meteorological observatory of Montsouris (Paris), and Dr. Stéphan director of the observatory at Marseilles. A well selected staff of astronomers, observers, calculators, &c., has also been appointed.

Velocity of Light.—J. Cornu.—With apparatus devised by Fizeau, but greatly improved, the author has recently made new investigations on the velocity of light. The figure found is 298,500 kilometres (about 185,000 English miles) in one second. It is incidentally mentioned that this figure gives for the sun's parallax the value 8″,86, while that of the Great Pyramid is for parallax 8″,8755″.

Aëronautical Ascension.—Gaston Tissandier.—With one of the large air-balloons belonging to the French Post Office Administration (used in the late siege of Paris), an ascension was made a few days ago by the author with the view of obtaining information on meteorological subjects. At 2000 metres above the earth (the starting-point being the large gas-works, Villette, Paris), and after having passed through layers of clouds, the author and his companions found a bright sunlit sky, and a temperature of from 17° to 18°. When descending and entering the clouds—found to be in highly electric state—the temperature decreased to −3°, and the balloon was surrounded with small crystals of ice.

Beet-Root Sugar Production of the Present Season.—Rev. F. Moigno.—France, 375 millons of tons; Germany, 250 millons; total for Europe, 1,025,000 tons against 873,280 tons in 1871-72.

Bibliography.—Coup d'Œil sur le Monde Invisible, par H. Ph. Adan. Paris: A. Ghio, 1873. An excellent treatise on microscopy.

Bulletin de la Société Chimique de Paris, No. 4, 1873.

From the *proces verbaux* of the meetings of this Society we quote the following particulars:—

Reduction of Erythrite by Formic Acid.—A. Henniger.—By the use of a large quantity of acid the author obtained, in addition to a glycol—

$$C_4H_8\{^{OH}_{OH}$$

a hydrocarbon C_4H_6, a colourless volatile liquid, yielding with bromine a compound $C_4H_6Br_4$, crystallising in rhomboidal shape; fusion-point, 116°.

Constituents of Compressed Coal-Gas.—M. Caventon.—The author is engaged with researches on the condensed substances met with in the *gaz comprimé*, as delivered to consumers in Paris. Some of the liquids condensed emit gas (become vapourised) at 0°; among these the author notices crotonylen, C_4H_6. Its combination with bromine is a solid compound, insoluble in water, soluble in ether and alcohol, fuses at 116°. By the reacting upon acetate of silver an ether is formed from the bromide.

The following original papers and essays are further contained in this number:—

Action of Bromine upon Bibromo-Succinic Acid. Formation of Tetra-Bromated Hydride of Ethylen.—E. Bourgoin.—The more detailed account of a paper already quoted (see Chemical News, vol. xxvii., p. 94).

Quantitative Estimation of Free or Dissolved Oxygen by Means of a Titrated Solution of Hydrosulphite of Soda.—P. Schützenberger and Ch. Risler.—This monograph is divided into the following sections:—Preparation of the hydrosulphite; titration of the hydrosulphite; description of the experimental method.

Statics of Saline Solutions.—Berthelot.

Synthesis of Propionic Acid by Means of Oxide of Carbon.—Berthelot.—By causing oxide of carbon to act upon alkaline solutions in alcohol, there is formed—but only in small quantity—a propionate of the base. A far larger quantity of formiate is formed, but this a secondary reaction. This essay is elucidated by a large number of formulæ.

Gazzetta Chimica Italiana, No. 10, 1872.

Contains the following original papers and memoirs:—

Preliminary Notice on a New Method of Synthesis of Acids of the Aromatic Series.—Dr. E. Paterno.—Although styled preliminary notice, the author details at length, first his theory, and next his results of experiments, confirming his views on the mode of formation of acids of the aromatic series by treating acetinyl-benzine with carbonic anhydride and sodium, whereby an acid is produced identical with Glaser's phenyl-propiolic acid; the new substance being a solid crystalline substance, soluble in water, fusing at 136° to 137°. The author elucidates his theory by a series of formulæ.

Preliminary Notice on Amido-monochlorosulpho-benzidic Acid.—L. Pratesi.—After referring to his researches on the dry distillation of phenylsulphate of aniline, the author records the results of his investigation on the dry distillation of phenylsulphate of toluidine, monochloro-phenolsulphate of aniline, and phenolsulphate of monochloraniline. The first yielded phenol and amidotoluol-sulphuric acid; the second yielded phenol, monochlorphenol, and amido-sulphobenzidic acid; the last gave, besides phenol, the amido-monochlorosulpho-benzidic acid—

$$C_6H_3Cl\{^{NH_2}_{SO_3H}$$

This paper is elucidated by a large number of complex formulæ.

Chemical Investigation on the Tuber of the Cyclamen.—Prof. S. de Luca.—This monograph records the chemical researches made by the author on the root of a plant indigenous to southern Europe. Among other more common vegetable substances, the root contains ciclamine, an amorphous, neutral, white-coloured substance, void of smell, very hygroscopic, gelatinising in cold water, and converted into glucose at 30° by the aid of synaptase. Ciclamine is converted into ciclamiretine by strong sulphuric acid; and by the action of fused caustic potassa ciclamine yields an acid, which is scarcely soluble in water. The percentical composition of ciclamine is—Carbon, 54·54: hydrogen, 9·12; oxygen, 36·34. It appears that the root alluded to, and more so its active principle ciclamine, acts as a poison on many animals, but pigs eat the root with impunity, and hence the vulgar Italian name of the root is *pane porcino*.

Annalen der Chemie und Pharmacie, Nos. 2 and 3 (double number), 1873.

The following original papers and essays are published in this number:—

Contribution to our Knowledge on the Aromatic Amines.—V. Meyer and O. Stuber.—This monograph, elucidated by a large number of complex formulæ, is divided into the following sections:—Fluid dibrombenzol from dibromaniline; tribrombenzol from tribromaniline; the three modifications of dibrombenzol; isomeric dibromanilines; action of nitrous acid ether upon some amides; benzamide; picramide.

Investigation on the Capability of Addition (Additions Fähigkeit) of Azobenzide.—A. Werigo.

Chemical Formula of Epidote.—E. Ludwig.—A mineralogico-chemical essay.

Franguline and Frangulinic Acid.—A. Faust.—After first referring to the researches of other *savants* on these substances, the author describes at length the methods of preparing, from the bark of *Rhamnus frangula*, franguline and frangulinic acid. The former is, in pure state, a lemon-yellow coloured crystalline substance; fusion-point, 226°; soluble in alkaline fluids, exhibiting an intense cherry-red coloured solution; formula—

$$C_{20}H_{20}O_{10}=\underbrace{C_{14}H_8O_4}+C_6H_{12}O_6.$$

Frangulinic acid.

Frangulinic acid is soluble in alcohol, but barely so in water; it is a crystalline body which, by reduction with zinc, yields, at red heat, anthracen. The combinations of frangulinic acid with bromine and other bodies, are described *in extenso*.

Heptylic Acid from the Hexyl-Alcohol of the Heracleum Oil.—A. Franchimont.—In the introduction to this paper the author reviews at length the results of the researches of other *savants* on acids belonging to this group. The preparation of heptylic acid, $C_7H_{14}O_2$, is then described at length. This substance is, in pure state, a colourless, oily fluid; boiling-point, 223° to 224°; sp. gr. at 24°=0·9212; not very soluble in water, but miscible, in all proportions, with alcohol and ether. At −18° this acid is solidified, but liquefies again at −8°. The ether, $C_7H_{13}(C_2H_5)O_2$, of this acid, and many of its salts, are next described at great length, and the paper ends with a lengthy discussion on the constitution of the acid and its proper place between the groups of the fatty acids.

Researches on Mucic Acid and Pyromucic Acid.—H. Limpricht.—This exhaustive monograph is divided into the following sections: Mucic acid, $C_6H_{10}O_8$; chloro-muconic acid, $C_6H_4Cl_2O_4$; hydro-muconic acid, $C_6H_8O_4$; adipinic acid, $C_6H_{10}O_4$; bromo-hydro-muconic acid, $C_6H_7BrO_4,H_2O$; dibromo-adipinic acid; tribrom-adipinic acid; trioxy-adipinic acid; tetrabrom-adipinic acid; pyromucic acid, $C_5H_4O_3$; tetraphenol, C_4H_4O; compounds of bromine and pyromucic acid; tetrabrom-butyric acid; tribrom-ethylen-bromide; iso-pyromucic acid; furfur-alcohol.

Description of an Apparatus for Regulating and Ascertaining the Pressure of the Vapours of Boiling Liquids.—L. Meyer.—Illustrated with engravings.

Estimation of Uric Acid.—R. Maly.

On Nicotine.—Dr. H. Weidel.—This essay, elucidated by a large number of complex formulæ, and woodcuts exhibiting shapes of crystals, treats mainly on the derivatives of nicotine.

Some Erroneous Statements as regards the Formation of Chloroform.—A. Belohoubek.—This essay contains the detailed account of a series of experiments relating to the formation of chloroform.

Analysis of a Magnetic Iron Ore obtained from a Blast Furnace.—O. Vœlker.—The substance alluded to was obtained from the Prevali Iron Works, in Carinthia. The sp. gr. of this partly crystalline mineral is 5·63. Composition, in 100 parts—Fe, 76·2; O, 23·8. Formula, $Fe_{11}O_{12}=(FeO)_3Fe_2O_3$.

Syngenite, a New Mineral from Kalusz (Galicia).—O. Vœlker.—This mineral, found in the saline deposits near the locality alluded to, consists, in 100 parts, of—CaO, 16·97; MgO, 0·46; K_2O, 28·03; SO_3, 48·04; H_2O, 5·91; total, 100·31. Formula, $CaSO_4+K_2SO_4+H_2O$.

Analysis of Epidote from the Untersulzbach Valley, in Salzburg.—F. Kottal.—The mineral alluded to consists, in 100 parts, of—SiO_2, 37·0; Al_2O_3, 22·10; Fe_2O_3, 13·80; FeO, 0·33; CaO, 25·15; MgO, 0·05; H_2O, 0·26

Revue Hebdomadaire de Chimie Scientifique et Industrielle, January 16, 1873.

Eau de la Couronne.—M. Ckiandi.—The detailed description of an industrial process of refining the light petroleum oils so as to obtain the eau de la couronne, a cloth- and leather-cleaning liquid; a substitute for turpentine and illuminating oils.

Description of a Hydraulic Press for Laboratory Use.—Thomasset and Noel.—Illustrated by woodcuts. Although termed hydraulic, the fluid is oil not water, and the manipulation quite different from the ordinary hydraulic press, but the effect is powerful although the machine is small.

Spray Producers, So-Called Pulverisators.—J. Gache.—Ingeniously contrived instruments, illustrated by woodcuts.

La Revue Scientifique de la France et de l'Etranger, February 22, 1873.

Contains no papers relating to chemistry, but attention is called to the following essay:—

The Scientific Origin of Nations.—W. Bagehot.

Reorganisation of the Medical Instruction in France.—M. Lacassagne.—A memoir which contains useful hints on the teaching of medical science in its widest sense.

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C., and 8, Houndgate, Darlington.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

429. J. P. Sharp, Birmingham, "Improvements in the manufacture of steel and in case hardening, or partially converting iron into steel."

435. C. W. Harrison, High Holborn, Middlesex, "Improvements in the treatment and use of air for the manufacture of gas for lighting and heating purposes, and in the apparatus employed therein."—Petitions recorded February 5, 1873.

445. S. J. Mackie, Delahay Street, Westminster, "Improvements in the manufacture of explosive compounds and in the apparatus used in such manufacture."—Petition recorded February 6, 1873.

458. A. Lafargue, Westbourne Park, Middlesex, "Improvements in the production of gas or vapour from hydrocarbon oils or combinations thereof with other matters, and in means or apparatus employed in utilising the same."—Petition recorded February 7, 1873.

528. C. W. Harrison, High Holborn, Middlesex, "Improvements in obtaining oxygen."—Petition recorded February 12, 1873.

NOTICES TO PROCEED.

2941. G. Robbe, Fenchurch Street, London, "A medical preparation applicable to the treatment of what is known as 'foot-and-mouth disease' in cattle."—A communication from J. M. Brunet, Dieppe, France.—Petition recorded October 5, 1872.

2959. W. Lorberg, North Bow, Middlesex, "A new or improved process for the manufacture of soap."—Petition recorded October 8, 1872.

2997. J. W. Perkins, Brixton, Surrey, "The manufacture of artificial fuel."—Petition recorded October 11, 1872.

3017. N. Bickford, Exmouth, "An improvement in the manufacture of soap."—Petition recorded October 14, 1872.

3080. H. Bethell, Victoria Street, Westminster, "Improvements in the treatment of beer, in order to prevent and remove acidity."—Petition recorded October 18, 1872.

3323. A. M. Clark, Chancery Lane, Middlesex, "Improvements in the manufacture of stearic acid."—A communication from E. Diess, Marseilles, France.—Petition recorded November 8, 1872.

3477. P. Jensen, Chancery Lane, Middlesex, "Improvements in the manufacture of steel."—A communication from T. Brooks, Minerva, Ohio, U.S.A.—Petition recorded November 21, 1872.

3525. J. Mitchell, Millbank Street, Westminster, "A new or improved cretaceous hydrocarbon fuel."—Petition recorded November 25, 1872.

205. M. Williams, Wigan, Lancashire, "Improvements in the manufacttre of gas."—Petition recorded January 17, 1873.

393. J. McDougall, Manchester, "Improvements in the manufacture of manures."—Petition recorded February 1, 1873.

PATENTS SEALED.

2476. A. Deiss, Plaistow, Essex, "A new or improved process of percolation for the purpose of extracting fatty, resinous, and similar matters."—Dated August 20, 1872.

2529. H. A. Dufrené, Rue de la Fidélité, Paris, "An improved mode of preserving fruit."—A communication from F. Sacc, Neuchatel, Switzerland.—Dated August 26, 1872.

2619. F. R. H. Protheroe, Lydney, Gloucestershire, "Improvements in the manufacture of paper."—Dated September 3, 1872.

2642. C. W. Torr, Aston, near Birmingham, and J. Johnstone, Birmingham, "Improvements in furnaces for heating and melting metals and metallic alloys."—Dated September 5, 1872.

3163. A. Alison, Bayswater, Middlesex, "Improved means of preserving and curing raw meat, in packing the same, and in apparatus employed therewith."—Dated October 25, 1872.

3292. E. J. W. Parnacott, Leeds, "Improvements in artificial fuel, part of which improvements having reference to the means or apparatus employed in the manufacture of the same."—Dated November 6, 1872.

3678. W. R. Lake, Southampton Buildings, London, "Improvements in the manufacture of malleable cast-iron and cast-steel, and in furnaces therefor."—A communication from J. M. Roberts, Burlington, New Jersey, U.S.A.—Dated December 5, 1872.

3853. F. B. Houghton, Borough Road, Southwark, Surrey, "Improved method of, or process for, treating spent hops for the manufacture of paper-pulp."—Dated December 19, 1872.

3882. W. W. Fereday, Dover Road, Surrey, "Improvements in treating human excreta, and in apparatus for working the excreta and converting the same into a dry and highly concentrated manure."—Dated December 21, 1872.

3949. J. Higgin, Manchester, and J. Stenhouse, Pentonville, Middlesex, "Improvements in treating waste liquors containing arsenical or phosphatic compounds, and in obtaining and applying useful products therefrom."—Dated December 30, 1872.

NOTES AND QUERIES.

Becker's Mercurial Earth.—Can any of your readers give me information about a salt known as "Becker's mercurial earth," its composition, how or where I can procure it, and if it is put to any use in the arts? I cannot find it mentioned in any of the modern manuals of chemistry.—G. G. EVANS.

Determining Ammonia in Gas.—Dr. Vogel determines the ammonia by passing gas slowly through aluminum sulphate, whereby an ammonia-alum is formed; he suggests that alum be made in this way for commerce. For determining the quantity of ammonia in tobacco-smoke, he passes it through an alcoholic solution of tartaric acid, when the acid tartrate of ammonia is formed.—*Am. Chem.*

MEETINGS FOR THE WEEK.

MONDAY, March 3rd.—Medical, 8.
—— London Institution, 4.
—— Royal Institution, 3. General Monthly Meeting.
TUESDAY, 4th.—Civil Engineers, 8.
—— *Zoological*, 8½.
—— Royal Institution, 3. Prof. Rutherford, "On Forces and Motions of the Body."
WEDNESDAY, 5th.—Society of Arts, 8.
—— Microscopical, 8.
—— Pharmaceutical, 8.
THURSDAY, 6th.—Royal, 8½.
—— Royal Society Club, 6.
—— Royal Institution, 3. A. Vernon Harcourt, F.R.S., "On the Chemistry of Coal and its Products."
—— Chemical, 8. Dr. C. R. A. Wright, on the "Action of Hydrochloric Acid on Codeine." P. Hannay, "New Processes for Mercury Estimation, with some Observations on Mercury Salts." Dr. T. E. Thorpe, "On a Method of Estimating Nitric Acid." F. Field, "Note on the Action of Acetates upon Solutions of Plumbic Salts, with Remarks upon the Solubility of Plumbic Chloride."
FRIDAY, 7th.—Royal Institution, 9. James Dewar, F.R.S.E., "On the Temperature of the Sun and the Work of Sunlight."
—— Geologist's Association, 8.
SATURDAY, 8th.—Royal Institution, 3. Prof. W. K. Clifford, M.A., "On the Philosophy of the Pure Sciences."

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THE CHEMICAL NEWS.

VOL. XXVII. No. 693.

THE CONSTITUTION OF CITRIC ACID.

By S. E. PHILLIPS.

THE radical of citric acid is considered by Hofmann and others to be $(C_{12}H_5O_8)$, and that, as a tri-atomic, it replaces 3H, and, further, that the acid is tribasic.

Of the many doubtful points of speculation, in which too much of positivism and assurance are based, this hypothesis of triatomic or pentatomic equivalence is perhaps one of the weakest.

That any radical or element whatever replaces, or is equivalent to, two, three, four, five, or more atoms of H, is a matter of which I see *no evidence whatever*.

The subject of polybasic organic acids is one that well demands a careful re-examination.

We now moot that citric acid is pentabasic, and that the radical is $(C_{12}H_3O_8)$, and as the tribasic citraconic acid gives citraconanilid, $(C_{10}H_3O_4)PhHN$, so we may obtain citranilid, $(C_{12}H_3O_8)PhHN$.

The glyceride CITRIN is a good confirmation of this view. Assuming that a monacid substitution in glucosides or glycerides, &c., requires the formula "*minus* 2HO," an acid with 5HO of base would require a subtraction of 6HO, whence we have—

Citric acid + glycerine − 6HO = CITRIN = $C_{18}H_{10}O_{14}$,

or, instead of $(C_6H_7O_4)O+HO$, we have—

$$\left.\begin{matrix}C_6H_6O_4\\C_{12}H_3O_8\end{matrix}\right\},O+HO=C_{18}H_9O_{12},O+HO$$

But this glyceride or alcohol is a kind of anhydride to the real glycer-citric acid, which, like the citric acid itself, also seems to saturate 5HO; hence we have—

CITRIN, the so-called anhydride, $C_{18}H_9O_{12},O+HO$
The acid, $C_{12}H_9O_{12},O+5HO$

The corresponding mannitanide is a still better confirmation—

Citric acid + mannitan − 6HO = citro-mannitan = $C_{24}H_{14}O_{18}$
2 citric acid + mannitan − 12HO = dicitro-mannitan = $C_{36}H_{16}O_{26}$

Instead of mannitan, $C_{12}H_{11}O_8,O+HO$, we now have—

$$\left.\begin{matrix}C_{12}H_{10}O_8\\C_{12}H_3O_8\end{matrix}\right\},O+HO=C_{24}H_{14}O_8,\text{ and}$$

$$\left.\begin{matrix}C_{12}H_6O_8\\C_{12}H_3O_8\\C_{12}H_3O_8\end{matrix}\right\},O+HO=C_{36}H_{16}O_{26}$$

This latter in some books is given as $C_{30}H_{20}O_{30}$; therefore it is quite clear that we have—

The anhydride, $(C_{36}H_{15}O_{24})O+HO$
The di-acid, $(C_{36}H_{15}O_{24})O+5HO$

In the case of Hofmann's "citryl triphenyl biamide" he has the number 6, by making the citryl radical tri-atomic, or as replacing 3H, thus $(C_{12}H_5O_8''')Ph_2HN_2$. On the view we have taken it would be $(C_{12}H_3O_8)Ph_2H_3N_2$, and, in accordance herewith, the citric ethers would be—

	Hofmann.	Phillips.
Primary ..	$(C_{12}H_5O_8)O_3+EO,2HO$	$(C_{12}H_3O_8)O+EO,4HO$
Secondary ..	$(C_{12}H_5O_8)O_3+2EO,HO$	$(C_{12}H_3O_8)O+2EO,3HO$
Tertiary ..	$(C_{12}H_5O_8)O_3+3EO$	$(C_{12}H_3O_8)O+3EO,2HO$

One cannot but be struck with the anomalous 3O apart from the radical; we might compare this feature with glycerine, which Hofmann notates with three O apart from the radical, but its derivative constitution and general properties we think will not bear that exceptional interpretation.

The sulpho-glyceric acid is in close parallelism with all other well-known sulpho-acids—

Sulpho-ethylic,	$HO,SO_3+(C_4H_5)O,SO_3$
Sulpho-acetic,	$HO,SO_3+(C_4H_3O_2)O,SO_3$
Sulpho-glyceric,	$HO,SO_3+(C_6H_7O_4)O,SO_3$
Sulpho-saccharic,	$HO,SO_3+(C_{12}H_{11}O_{10})O,SO_3$
	&c., &c.,

and it must be distinctly understood that these radicals, as here pourtrayed, replace one H in ammoniacal types.

Naquet gives the following ammonia derivatives:—

	Contain the elements of	Phillips.
Citric acid diphenyl diamide	$(C_{12}H_5O_{10})Ph_2H_3N_2$	$(C_{12}H_3O_8)Ph_2H_4N_2O+HO$
Phenyl citramide	$(C_{12}H_5O_8)Ph_3H_3N_2$	$(C_{12}H_3O_8)Ph_3H_5N_2$
Neutral citro-amide..	$(C_{12}H_5O_8)H_6N_2$	$(C_{12}H_3O_8)H_6N_2$

Two citric *i*mides are known—

Phenyl citramic acid	$(C_{12}H_5O_{10})PhHN_2$	$(C_{12}H_3O_8)PhHN$
Citrimide	$(C_{12}H_5O_8)Ph_2HN_2$	$(C_{12}H_3O_8)Ph_2H_3N_2$

The first and last are evidently the same, excepting that the first is a simple hydrate or acid form of the latter, which is an *a*mide. Of *i*mides I know nothing whatever!

The *i*mide phenyl citramic acid (!) puzzled exceedingly, nor could I, except with one N, at all imagine such an arrangement of atoms. On venturing this suggestion, and asking for enlightenment in the CHEMICAL NEWS, the reply was "You are right; phenyl citramic acid has only one N to eleven H." The French edition has also made the same error (CHEMICAL NEWS, vol. xxv., p. 47).

This so-called *i*mide, and, at the same time, *aminic acid*, is notated by Naquet as—

$$\left.\begin{matrix}\left.\begin{matrix}C_6H_4O_3\\H-H+\end{matrix}\right\}''O_2\\C_6H_5\end{matrix}\right\}N_2$$

Against the general view here taken, Naquet says that "citric acid has three atoms of H replaced by metals, and the fourth only by acid radicals; hence it is tribasic and tetra-atomic," but he very strangely gives metallic salts containing more than three atoms of base—

Citrate of lead $=(C_{12}H_3O_8)O+4PbO,HO$
Citrate of copper $=(C_{12}H_3O_8)O+4CuO,HO$

The following analogues are here given in a provisional sense, as the wide subject of polybasic acids is under consideration—

Tartramide,	$(C_8H_3O_8)$	H_5N_2
Tartranilide,	$(C_8H_3O_8)Ph_2H_3N_2$	
Tartranil,	$(C_8H_3O_8)Ph$	H N
Tartramic acid,	$(C_8H_3O_8)$	H_3NO+HO
Tartranilic,	$(C_8H_3O_8)Ph$	H_2NO+HO
Citraconamide,	$(C_{10}H_3O_4)$	H_5N_2
Citraconimide,	$(C_{10}H_3O_4)$	H_2N
Phenyl citraconamide,	$(C_{10}H_3O_4)Ph$	H N
Citraconamic acid,	$(C_{10}H_3O_4)$	H_3NO+HO
Phenyl-citraconamic acid,	$(C_{10}H_3O_4)Ph$	H_2NO+HO
Comenamic acid,	$(C_{12}H_1O_6)$	H_3NO+HO

At the outset of this enquiry I was puzzled by the special prominence given to the *tri*amide form for the citric ammonia, and the diamide form similarly assigned to succinamide and other supposed diatomics. This is well seen in the following triplet:—

Phenyl benzamide,	$(C_{14}H_5O_2)Ph$ H N
Phenyl succinamide,	$(C_8H_3O_4)Ph_2H_3N_2$
Phenyl citramide,	$(C_{12}H_3O_8)Ph_3H_5N_3$

How little this is founded on fact may be seen in the fol'owing, taken from the same authority (Watts's "Dictionary"):—

Aniline + succinic acid − 2HO = phenyl-succinic acid, $(C_8H_3O_4)PhH_2NO+HO$.

Aniline + citric acid − 4HO = phenyl-citramic acid, $(C_{12}H_3O_8)PhH_2NO+HO$.

2 aniline + citric acid − 4HO = diphenyl-citramic acid, $(C_{12}H_3O_8)Ph_2H_4N_2O+HO$.

Now the amide or ammonia form of phenyl-citramic acid would necessarily be $(C_{12}H_3O_8)PhHN$, which proves the Hofmann radical to be an impossibility, and, for the

complete confirmation of the burden of this paper, it only needs that we should obtain the corresponding diphenyl citramide, $(C_{12}H_3O_3)Ph_2N$.

Finally, it is plain that if these principles be applied to the identification of organic radicals, that the diatomic alizarine, and an infinitude of others, will vanish into a clear comprehension of the simple truth.

ON THE DISSOCIATION OF OXIDE OF MERCURY.

By J. MYERS.

Debray*, in 1867, promised that he would publish his researches on the dissociation of mercury, but he has not yet done so. No older researches on this subject exist, except those of Pelouze and Gay-Lussac†, from which it resulted that the decomposition of the two modifications of that oxide begins at the same temperature. My experiments only relate to the red modification of the oxide of mercury, which, of course, I took care to prepare in pure state, so as to be quite free from suboxide, which is decomposed at 100°. The red oxide of mercury of commerce always contains suboxide; and I therefore prepared the oxide by ignition (gentle heating rather) of the nitrate prepared from pure mercury, obtained by reducing crystalline cinnabar by means of iron, the metal being next dissolved in nitric acid. The oxide so prepared was not, however, quite free from suboxide, which was eliminated by heating it with nitrate of ammonia. The oxide was put into a glass tube which had previously been weighed, and which was connected with a Geissler pump. Prior to this I had, however, measured—(1), the cubical capacity of the balloon of the pump, taking a mark made on it as starting point; (2), the cubical capacity of the tube and other parts of the apparatus; (3), the diameter of the barometer tube of the pump. This enabled me to control the indications of the manometer (pressure gauge) by means of the balance, and I found that they agree with each other.

The tube filled with oxide was in these experiments heated to the requisite temperature by the following means:—(1), in an air bath kept at a constant temperature by the modified Schlösing's temperature regulator; (2), in a bath of mercury and sulphur for temperatures of 350° and 440°; (3), a bath of sulphur and zinc for temperatures of 400° to 560°, the heat being regulated by adjusting the gas-flame by a well-made tap. The determination of these high temperatures was effected by the aid of Berthelot's air thermometer. Before weighing the tube it was always cooled by the aid of a Liebig condenser. In the first experiments the tube was heated to 105·5° for an hour; the manometer did not indicate any pressure. In the second experiments the tube was heated to 150° for an hour; the result was that oxygen was evolved, but in too small a quantity to exert any pressure; a deposit of mercury was also visible. At 240° the tension of the mercury was, after an hour's heating, 2 m.m., and did not increase by continuing the experiment. For about two hours the temperature was kept at 293°, and the tension was 2½ m.m. No increase was observed during the second hour. These four experiments prove that the maximum of tension is reached in a short time, while it (the tension pressure) is very small, and amounts only to a very small fraction of the atmospheric pressure. In the fifth experiment I heated the tube to 350° in an air bath, the temperature of which was kept constant, and determined by an air thermometer. After having continued the application of heat to the tube for about the same time as in the previous experiments, the pressure exerted by the oyxgen amounted to 8 m.m., which was found to be the maximum for this temperature. I heated the tube to 400° for five hours; at the end of this period the manometer still rose (mercurial gauge), the pressure was 16 m.m.

It was not an easy matter to keep the temperature of the boiling sulphur bath constant. The tube was in it for thirteen hours; after seven hours the pressure was 39 m.m., and it increased during the last 6 hours by 27 m.m. The tube was next transferred to a bath of molten zinc kept at 560°. After seven and a quarter hours the pressure of the oxygen under these conditions was 343 m.m. After three hours and a half the pressure was 271·5, and by observing and noting the reading of the manometer every quarter of an hour, I found that maxima and minima occur as exhibited by the following figures:—304, 369, 315·5, 323, 329·5, 334·5, 339, 343.

This experiment also enabled me to estimate the melting-point of the ordinary zinc of commerce, which I found to be 440°. The course of the experiments just alluded to, and the fact that in no instance a decrease of the tension of the oxygen occurred either when the cooling was rapidly or slowly effected, rendered probable the view with which I undertook these researches. The looseness of the combination of mercury and oxygen made it reasonable to expect that an anomaly of the dissociation should arise, and this the more so if Pfaundler's* definition of dissociation is viewed as correct. But the main point of that definition, viz., that by a given constant temperature as large a number of molecules are split up as are by contact reunited, so that, in fact, a condition of equilibrium is obtained (maximum of tension), does not, I think, hold good in the case of oxide of mercury; because only the first parts of the definition just given obtains with it and not the second.

In order to make sure of the correctness of my first researches, the results of which were somewhat contrary to my expectations, I again placed the tube in a bath of boiling sulphur, having first filled the apparatus with 66 m.m. of oxygen, the same quantity left in the apparatus at a previous experiment. The stopcock of the air pump was so adjusted that the balloon of the pump did not form part of the apparatus. The tube was heated for twenty and a half hours, the pressure of the O increased by 60 m.m.; yet in this case also, the increase of the pressure was not uniform, as may be seen from the subjoined tabulated form:—

Duration of Experiment. Hours.	Reading of the Manometer. At the Beginning. m.m.	At the End. m.m.	Increase per Hour. m.m.
3¾	66	74	2·13
2¾	60	87	2·54
4¼	87	101⅜	3·45
4	101⅜	115⅝	3·50
4	115⅝	123⅜	2·50

After this, the stopcock was so adjusted that the balloon became part of this apparatus, and then the heating was continued for fifty-one and a quarter hours (but consecutively only for twenty-four); the tension of the oxygen rose to 165·5 m.m., an increase of 47·5 m.m. On opening the stopcock, the tension in the apparatus was 418 m.m. Thus, if the capacity of the apparatus applied in this instance had been the same as before, the tension would have been increased by 111 m.m., and hence it is evident that the evolution of oxygen is only slowly decreasing. After having exposed the apparatus to heat for eighty-five hours, and finding that the end of the experiment was far from being obtained, I again introduced oxygen into the apparatus until the tension became 337 m.m. Taking the results of the previous experiments as basis, it would have required two hundred hours' heating to reach this tension. I next heated the tube again for fully fifteen and a half hours, and the results of this operation are quoted in the subjoined form; but I ought to observe that the reading off took place from a distinct mark, 738·1 m.m. above the mercury contained in the reservoir:—

* *Comptes Rendus*, 1867, 603.
† *Ibid.*, vol., xvi. 310.

* *Pogg. Ann.*, 131, p. 54.

Duration of Experiment. Hours.	Reading of Barometer at Beginning.	Reading of Thermometer at the End.	Reading on the Barometer Tube.	Difference.	Calculated for the Capacity of the former Table.
4½	757·3	10¼	318	2·3	5·13
	754·2	10	323		
3¼	754·4	7½	318	1·3	3·03
	757·1	10¼	320		
7¼	758·4	6¼	315	3·2	2·47
	757·2	14½	329		

The figures of the sixth column indicate that the evolution of oxygen decreases very slowly while the pressure of the gas increases. The arrangement of the apparatus did not admit of experimenting with the oxygen at atmospheric pressure, but I have no doubt that at the temperature of boiling sulphur a maximum of tension for the oxygen evolved from the oxide of mercury does not occur. The fact, however, of the very slow decrease of the evolution of this gas is, I think, accounted for by the weakening of every chemical action by pressure. I did not consider it necessary to repeat these experiments at higher temperatures, but I made some at lower temperatures which proved that for that temperature there exists a maximum of tension of oxygen of 8 m.m., as also proved by my first experiments. Even when the heating of the tube is continued for a period of thirteen hours, no difference is produced in the reading of the manometer.

The results of this investigation may be summarised as follows :—The dissociation of oxide of mercury is, up to a certain temperature, quite normal; but the apparatus (tube containing the oxide) being cooled, either more slowly or more rapidly, no decrease of tension of the oxygen is observed. When the limit of the above temperature is exceeded, no maximum of tension is reached, because the dissociated molecules have obtained more motion than is required for their combination. For every temperature, therefore, above that limit the decomposition of the oxide is complete, provided the application of heat be continued long enough.

The hypothesis is often brought forward that a temperature for every substance may be assumed to exist, at which the motion of every molecule is just so great that its tendency of combination with other substances is equal to O. It is clear that this temperature must differ for each individual substance, and also differs towards other bodies. I think that, as regards mercury and oxygen, this temperature is about 400°. This is also proved by the fact that when mercury is boiled in open vessels the oxide is formed at a distance of some few centimetres above the surface of the boiling fluid. When, however, mercury is heated to only 300°, some oxide is also formed, but it then remains close to the fluid. This can only be explained, seeing that the temperature at the distance of some few centimetres above the surface of the metal is far lower, by assuming that at 350° the molecules of mercury possess the maximum of motion with a minimum tendency of combining with oxygen. The temperature 400° is in all likelihood too high as limit. I have, at present, had no time to experiment with the yellow oxide of mercury, but I hope shortly to do so, and also to operate with the oxides of silver and gold, and thus obtain a clue to the slowness of the dissociation of mercury.—*Ber. de. Deutsch. Chem. Gesells.*

ANALYSIS OF ANIMAL CHARCOAL.

By T. L. PATTERSON, F.C.S.

THE letter of your correspondent "F.C.S." (CHEMICAL NEWS, vol. xxvii., p. 104) prompts me to communicate a few observations on the above subject. On a future occasion I hope to go more fully into the composition and analysis of charcoal.

Animal charcoal when new and of good quality contains about 4·5 per cent of organic matter. A small portion is soluble in water, the greater part is soluble in acid, and the remainder is insoluble in either menstruum. Now, when charcoal is ignited the loss of weight is equal to the carbon + organic matter + water. Whereas when it is treated with acid, and the insoluble collected on a filter, washed, dried, and weighed, the contents of the filter, after deducting the sand left on ignition, consists of carbon and only the small portion of organic matter insoluble in the acid solution. If the result obtained by the ignition method after deducting the water be recorded as carbon, it will be found to be 4 per cent or so, more or less, than that obtained by solution; because in the first case the total organic matter is included, while only that portion insoluble in acid is recovered in the latter method.

It is the practice of most chemists in analysing animal charcoal to estimate water, carbon, carbonate of lime, sulphate of lime, oxide of iron, alkaline salts and sand, extending the difference as phosphate of lime and magnesia. In my future communication I will endeavour to show how erroneous this is, not only with regard to the organic matter, but also as to another constituent of the char. One of the constituents included in this difference is organic matter, which I believe ought to be always accurately and separately determined, since it not only enhances the value of the analysis, but gives important information as to whether the char has been properly burned. Thus when the organic matter amounts to 5 per cent, it may be taken as an indication that the char has not been long enough burned, or high enough heated in the process of its manufacture. And, conversely, when it falls much below 4 per cent it is likely the sample has been over-burned. Home-made char is sometimes under-burned, while that of foreign origin is as often over-burned. Of the two evils under-burning is the least.

Having during the last five or six years analysed a great many samples of charcoal from various sources, and having invariably determined the organic matter contained therein, I may say as the result of my experience that in new charcoal it amounts to between 3·23 per cent and 5·9 per cent dried at 212° F. And in old char, or the stock charcoal of sugar houses, the organic matter fluctuates between 0·2 and 1 per cent, according as the char has been carefully or imperfectly re-burned.

I always dry from four to five hours in the water-bath, and not at 350° F., because at the latter temperature a portion of the organic matter is driven off, and a high result obtained.

There is just one other remark about the estimation of moisture in char which I would like to make at present, because I believe from not knowing it many have been led to too low a result. When a sample of charcoal contains 5 to 10 per cent, and the water be determined in a portion of the ground as well as in the unground charcoal, it will be found that the result obtained in the latter case exceeds that in the former by 1 or 2 per cent, and proportionately less when the original sample contains 1 per cent and less of water. This shows that the char loses moisture during the operation of grinding. Consequently in making a full analysis it is necessary to make two water estimations, one in the ground and another in the unground portion. The former is that used for making up the results of the analysis and calculating to dry charcoal, while the latter is that reported as actually existing in the sample.

ON THE SULPHUR DEPOSITS OF KRISUVIK, ICELAND.

By CHARLES W. VINCENT, F.C.S.

THE canton of Krisuvik, in the district of Gullbringu, in the south-west corner of Iceland, has long attracted great interest on account of its boiling mud cauldrons, hot springs, and, above all, its "living" sulphur mines; these are all arranged in lines, evidently corresponding to the great volcanic diagonal line stretching from Cape Reykjanes

to the lake of Myvatn. At the present time, the greatest amount of volcanic activity is manifested at the southern end of this line, in the district some peculiarities of which I now propose to bring before you.

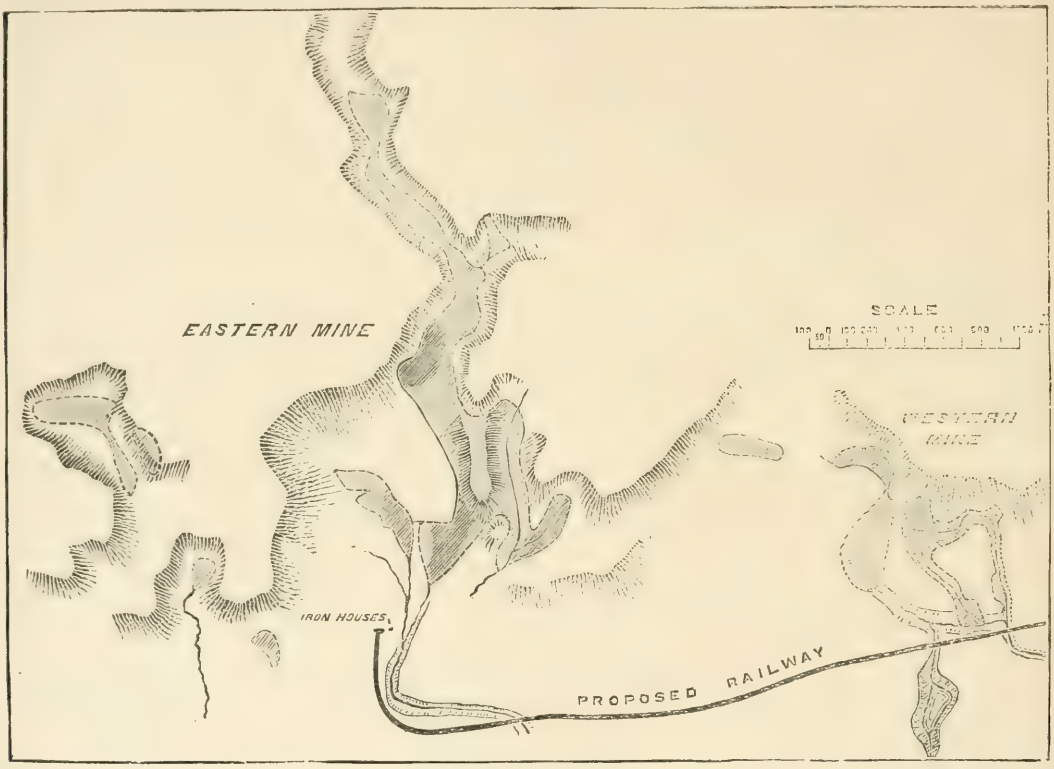
In the last century it was the northern end of the volcanic diagonal, near about Myvatn, where, according to the Icelandic records, the kind of pseudo-volcanic action was most vigorous, by which the boiling springs are set in operation and the sulphur deposits are formed; but a violent eruption of the mud volcano, Krabla, to a great extent buried the then active strata beneath enormous masses of volcanic mud and ashes, so that the energy has been probably transferred along the line southwards.

The Krisuvik springs are in a valley beneath some high mountains (see plan; the shaded portion represents the sulphur beds surrounding the active springs). They are reached by a track, so narrow that there is no more than room to enable horses to pass along it—across the brink and along the side of a vast hollow, termed the "kettle." Following this rude track, the "Ketilstip," the summit of the range of hills, is reached which overlooks Krisuvik. In the midst of a green and extensive morass, interspersed with a few lakes, are cauldrons of boiling mud, some of them 15 feet in diameter, numberless jets of steam, and boiling mud issuing from the ground, in many instances to the height of 6 or 8 feet. Sir George Mackenzie (who was accompanied by Sir Henry, then Doctor, Holland, now the President of the Royal Institution), in his justly-celebrated "Travels in Iceland, in 1810," gives a vivid word-picture of the scene. "It is impossible," he writes, "to convey adequate ideas of the wonders of its terrors. The sensation of a person, even of firm nerves, standing on a support which feebly sustains him, where literally fire and brimstone are in incessant action, having before his eyes tremendous proofs of what is going on beneath him, enveloped in thick vapours, his ears stunned with thundering noises. These can hardly be expressed in words, and can only be conceived by those who have experienced them."

The photographs which I have the honour to exhibit are many of them taken from paintings made on the spot by Mr. Waller, a nephew of Prof. Huxley, who certainly, by his faculty of close and accurate observation, does great credit to his distinguished relative. I have obtained from him corroboration of many facts which, though they might be expected to be noted by a chemist, or physicist, do not lie within the ordinary vocation of an artist.

On the other side of the mountains, subterranean heat is also manifested, and hot springs, accompanied by sulphur beds, are also found; but they have not been as thoroughly examined as those in the valley, and are represented as being less active.

Mr. Seymour, who has spent many months at Krisuvik, tells me that the sulphur beds on this side have been sub-



merged by the clays washed down by the winter rains, and are, for the most part, now completely overgrown with grass. On digging beneath the surface, however, the sulphur earth is found to be only a short distance down, and on analysis the percentage of sulphur in one bed, 116 yards long, running up the side of the mountain, was discovered to range between 64 and 65·5. Here the earth was completely cold, and all further deposition of sulphur appeared to have ceased.

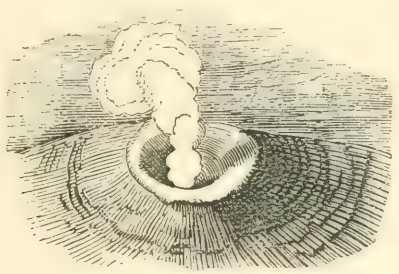
In the valley itself the springs are not always visible at the surface, being so completely covered by the earth, that it is only by piercing through the crust of indurated sulphur earth that their presence is discovered. Sometimes the explorer is made unpleasantly aware of the insecure nature of his footing by falling through, and thus opening up a fresh thermal spring. The late Sir William Hooker, when visiting this place, in endeavouring to escape a sudden gust of strongly odourous vapour, jumped into a mass of semi-liquid hot earth and sulphur—and but for his presence of mind, in throwing himself flat upon the ground, would have sunk to a considerable depth; as it was, the difficulty of extricating himself was very considerable.

The surface of the ground is covered in many places with a crust of 2 to 3 feet in depth of almost pure sulphur;

and in the valley, where the steam jets are protected from the extreme violence of the wind, the sulphur is deposited tolerably evenly over the whole surface. If it were not for the ever-varying direction of the wind, the sulphur would, Captain Forbes is of opinion, be precipitated in regular banks, but it hardly ever falls for twenty-four hours in one direction, the wind capriciously distributing the shower in every direction.

It has been suggested by those who wish to utilise the immense sulphur-producing power of this wonderful locality, that chambers should be erected (Sir George Mackenzie), or walls built up (Dr. Perkins), by which means, the force of the wind being broken, the sulphur would be quietly floated to the ground, instead of being carried up the sides of the hills, and thus more widely distributed.

With little variation the general appearance of the "solfataras," over the space of 25 miles along the volcanic diagonal, is much alike; an elevation about 2 feet high and 3 feet in diameter, which is composed of a dark bluish-black viscid clay, forms a complete circle round the mouth of a medium-sized spring. The water is sometimes quiescent, and sunk about 2 feet within the aperture; at other times it is ejected, with great hissing and roaring noise, to the height of from 5 to 8 feet. At all times clouds of steam, strongly impregnated with sulphuretted hydrogen and sulphurous acid gas, issue from the orifice,



both of which, during an eruption of the water, are greatly augmented in quantity. From the dark-coloured and evelated margin of the fountain the yellow crust of crystallised sulphur extends a great distance in every direction. Columns of steam ascend from numberless points in the whole district, which are thus impregnated; and thus it is that, apparently for ages past, sulphur has been gradually heaped up in this locality till there are actually hills, which, as far as they have yet been pierced, show sulphur-earth to be their main constituents; hence they have acquired the name of the Sulphur Mountains.

The soil is of different colours, but most generally white. It is, in the vicinity of the springs, a viscid earth, less plastic than clay, and more readily broken.

When excavations are made into this earth, it is found to be composed of multitudinous layers, of different colours or shades of colour, each layer being quite distinctly divisible from those above and below it, though frequently no more than an inch or two in thickness.

It is much to be regretted that the good example set by Olafsen and Povelsen, of investigating the nature of the earth's crust round about the solfataras by piercing the soil, has not been more frequently carried out. In the summer of last year one of the suggestions which I made, for the instruction of an expedition to this place, was that boring implements should be taken out and extensively used; but accident prevented the necessary appliances being forthcoming at the right time. I believe, however, that one of the chief features in the expedition which is to set out in March, will be the thorough examination, to as great a depth as practicable, of the strata in various parts of the sulphur-valley.

The spring chosen by Olafsen and Povelsen as the subject of their first experiment, was one which had made its appearance since the preceding winter, and which was just beginning to be surrounded by other mud springs and jets of steam. The ground was still covered with lovely verdure, and charming flowers were abundant, even at the very verge of the cauldron of hideous hue and odour. A short distance from this opening they established their boring apparatus. The sequence of the layers was as follows:—

1. Three feet of reddish-brown earth, of a fatty consistence, of the ordinary temperature; at the bottom heat was perceptible to the touch.
2. Two feet of a firmer kind of earth, nearly the same in colour as the first layer, unctuous to the touch.
3. One foot of a lighter kind of soil.
4. Five feet of a very fine earth of different colours, the first 2 feet being veined red and yellow, with streaks of blue, green, red, and white intermingled. The lower portion of this earth was somewhat firmer than that which covered it. The heat of this thick bed was so great that the soil extracted by the auger could not be handled until it had been for some time exposed to the air.
5. One foot of a compact greyish-blue earth.
6. In tapping this bed, which was 4 feet 9 inches in thickness, and consequently at a depth of about 12 feet, water was first met with. It was found by comparison that the level of the water in the boiling mud spring coincided at this time with that of the water thus discovered. The heat was now very great, and a constant hissing and bubbling could be heard as proceeding from the bottom of the hole which had been made.
7. Nine inches of greyish-blue earth.
8. One foot six inches of a similar unctuous earth, containing many small white stones. This was the hottest layer of any yet pierced; the buzzing humming noise was now much louder than before.
9. Three feet of the same kind of clay, but much harder and more compact; this layer was also full of small, round, white stones.
10. Six inches of a violet-tinged earth, very greasy to the touch. In this bed the heat sensibly diminished.
11. One foot six inches of red and blue clay intermingled. The heat continued to diminish very fast.
12. One foot of reddish-looking clay, the temperature remaining about the same.
13. Six inches of yellow and red clay.
14. One foot of a greenish-coloured earth, much less coherent than the previous layers. Here the heat again began to increase.
15. One foot six inches of blue clay, filled with small pieces of white tufa. This bed was much hotter than either that above or that below it.
16. One foot three inches of soft blue clay.
17. Nine inches of an earth, easily pulverised when dry, which, whilst moist, was of a violet colour; on exposure to the air, however, this rapidly changed to a chocolate-brown. The heat was again augmented as the centre of the bed was approached.

At thirty-two feet the full length of the boring implements was used up; but, from the set of the country in the vicinity, the experimenters believed they were close upon basaltic rock, when the heat probably ceased.

In digging for the peculiar kind of browncoal which they call "surturbrand" (a kind of fuel very much resembling Irish bog-oak, which can be used for like purposes), the inhabitants frequently go as deep as 28 feet. They report that before reaching this depth they frequently pass through three or four beds of blue, yellow, and brown clay, and almost invariably find that the layers of blue clay are much hotter than any of the other strata.

A second trial of the soil was made in the neighbourhood of some recent springs, further to the east. The activity of the agencies at work here appeared to be greater than in the former case, and to have been longer in operation. The whole surface was thickly covered with sulphur in a finely-divided state; there was much gypsum, and a large efflorescence of feathery alum. Thousands of very minute holes were discoverable on close examination, through

which continuous jets of steam, sulphuretted hydrogen, and sulphurous acid gases were emitted.

An attempt was made to dig with spades, but the soil was found to be so hot, whilst the footing was at the same time so insecure, that it could not be persisted it. A spot some distance further off was therefore pitched upon, where the earth was firmer and colder. The borer pierced through 6 feet of blue clay with great facility, the lowest portion being extremely hot. After this depth the earth became rapidly softer; at the depth of 7 feet the same peculiar bubbling noise before noticed was heard. Continuing to bore, the bottom of the hole appeared to be in a state of ebullition, a boiling liquid being ejected in the narrow space around the handle of the auger with extraordinary violence, and, no sooner was the tool withdrawn, than a thick black fluid was ejected from the orifice to the height of several feet. A short time afterwards the jet ceased, the subterranean fire appeared to have expended its fury, but it soon re-commenced with re-doubled activity to dart forth fresh jets of steam and black muddy water, continuing to boil and dance with but slight intermission. It appeared, therefore, evident that the result of this experiment was the premature formation of a fresh hot spring, which would otherwise have been, perhaps, a considerable time in forcing its way to the surface.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section).

Ordinary Meeting, February 24th, 1873.

Mr. E. C. C. Stanford, F.C.S., Vice-President, in the Chair.

A paper was read on "*The Chemical History of Anthracene, and its Production from Coal-Tar*," by Mr. R. F. Smith, Glenpark Chemical Works, Glasgow.

The author first devoted a considerable amount of attention to the nature and composition of coal-tar, incidentally tracing its history from before the Christian era down to the present time. Exact researches into the proximate composition of coal-tar were not attempted before 1848, the basic constituents being attaked first. Runge described carbolic, rosolic, and brunolic acids, Laurent confirming the existence of the first under the name of phenole. Hofmann, Fritzsche, Erdmann, Zinin, Anderson, Reichenbach, Young, Faraday, Mansfield, and other chemists each contributed to extend the knowledge of the composition of coal-tar; and many distinct chemical compounds were obtained from it. Proceeding to notice the chemistry of coal-tar as known at present, the author said that the substance varies much in specific gravity, some samples being as low as 1·00, and others as high as 1·15. The further away from retorts the lighter it is, the heaviest portion condensing first, while the condenser-tar, if it contains enough of oils to retain the naphthaline in solution, is very light. The more fluid the tar, the richer it is in naphtha. Crude naphtha is frequently found in considerable quantity, free from pitchy matter, in the "dreeps" between the purifiers and the gas-holder; and in the holder-tank it sometimes accumulates on the surface of the water. English tar generally contains less fluid matter than Scotch tar. In distilling the tar, water and naphtha are first separated, then the light oil, next ordinary creosote, or pitch oil, and sometimes there is obtained a further distillate, known as green oil, green grease, or heavy pitch oil, the residue in the boiler being pitch, which varies in hardness according to the amount of oil contained in it. The following is the average composition of coal-tar, as determined by the experience of many years in an English tar distillery:—

One ton of tar, sp. gr. 1·145 = 195·7 galls., yielded—

Ammonia water ..	3 galls. per ton.
First runnings	6 ,, ,,
Light oil	21¼ ,, ,,
Creosote, or pitch oil	66 ,, ,,
Pitch	11 cwts. 3 qrs.

The first runnings, rectified, yielded—

48 per cent of 50 per cent benzol	= 2·88 galls.	per ton of tar.
20 ,,	solvent naphtha	= 1·20	,, ,,
5½ ,,	burning naphtha	= 0·33	,, ,,
11½ ,,	"tailings"	= 0·69	,, ,,
15 ,,	loss		

The light oil yielded—

7 per cent of solvent naphtha	= 1·49 galls.	per ton of tar.
15 ,,	burning ,,	= 3·18	,, ,,
75 ,,	pitch oil	= 16·00	,, ,,

Or, in all, 1 ton of tar yielded—

50 per cent of benzole	= 2·88 galls.
Solvent naphtha	= 2·69 ,,
Burning ,,	= 3·51 ,,
Creosote oil	= 83·00 ,,
Ammonia water	= 3·00 ,,
Pitch	= 11 cwts. 3 qrs.

In the second part of his paper the author treated of anthracene, commencing with the discovery by Dumas and Laurent, in 1832 of a hydrocarbon, to which they gave the formula $C_{15}H_{12}$, and applied the name paranaphthaline. On making further examination, Laurent named the body anthracene. Fritzsche, in 1857, discovered a substance very closely resembling Dumas and Laurent's compound, and he assigned $C_{14}H_{10}$ as its formula. Anderson, in 1862, described a hydrocarbon of the same formula under the name of anthracene, although many of his observations differed essentially from those made by Laurent. In 1866, Limpricht synthetically produced anthracene by heating benzyl chloride with water to 180° C.; and in the same year Berthelot showed that it was obtainable by the action of heat on various simple hydrocarbons, such as toluol, a mixture of styrol and benzol, or a mixture of benzol and ethylene. He also confirmed Anderson's observations. Graebe and Liebermann, in 1868, obtained from alizarine a hydrocarbon posessing the same properties and composition as Anderson's anthracene. After giving an outline of the view generally taken of the constitution of anthracene, and showing its relation to benzol and other members of the aromatic group of hydrocarbons, Mr. Smith described the various methods by which anthracene is produced on the large scale. Probably not more than 10 tons of the commercial anthracene of 95 per cent has yet been produced in all the Scotch tar distilleries together, but in England the manufacture is proceeding on a more extensive scale, and as knowledge extends, additional works are taking it in hand. The great practical difficulty in the way of distilling the pitch for its contained anthracene is to find a proper arrangement of flues for the regulation of the heat. What is wanted is a sharp, quickly applied heat, sufficiently powerful to coke the pitch in a proper manner, and yet not strong enough to melt the iron walls of the retorts. Clay retorts have been tried, but they do not appear to answer, owing to the intermittent nature of the heat required, partial cooling being necessary after each charge, to allow the coke to part properly from the retort. Ordinary coke ovens with condensing arrangements do not suit, as part of the oil is burnt; the practical difficulties will, however, be overcome, and in many localities retorts for coking pitch have been in regular use for years. In working a charge, it is found that, under ordinary circumstances, all volatile matters can be driven off in about six hours; but the fire is still maintained a few hours longer, to get the coke hard enough. After cooling for some time, the coke is withdrawn and drenched with water. The first distillates in the operation are hydrogen gas and water vapour, with a little oil contain-

ing naphthalene, sp. gr. 0·97. When two-thirds of the oil has passed over coking commences, and towards the end of the operation permanent gases and hydrocarbons of low boiling-points appear. Finally, there is a red-yellow resinous sublimate, and the process is finished. The following is the result :—

Anthracenic oil, chrysen and pyren oil, and sublimed resin	27	to 30	per cent.
Gases, steam, and about 0·2 per cent light oils	25	,, 18	,,
Coke	48	,, 52	,,
	100	100	

The anthracene oil is soluble to the extent of 3 per cent in caustic soda, the dissolved matter yielding, on distillation, a red resinous body whose nature is at present unknown. The anthracene and chrysen oils are all mixed together and sent to the colour-makers, who subject the mixture to distillation, taking care to stop when the yellow matters begin to appear, the anthracene being separated in the usual way. The author described the properties of pure anthracene, its compounds, and its hydrogen and other derivatives, such as anthrachinon, the bromides of anthracene and others, and explained how they are prepared. He then passed on to show the chemical relationship between those derivatives and the alizarine of madder-root, and gave a short sketch of the various patents taken out by Graebe and Liebermann, Caro, Perkin and Dale, and Schorlemmer, for the manufacture of artificial alizarine, concluding with a brief notice of the industry which is now established in connection with it, both in this country and on the continent of Europe.

A short discussion followed, and the author was complimented for his very comprehensive and interesting paper.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, Monday, March 3rd, 1873.

Sir HENRY HOLLAND, Bart., M.D., D.C.L., President, in the Chair.

PROF. TYNDALL was present for the first time at a monthly meeting since his return from America, and on the motion of Sir Frederick Pollock, Bart., seconded by W. Pole, Esq., F.R.S., the following resolution was unanimously carried :—

Resolved,—That the warmest congratulations of the Members of the Royal Institution be offered to their Professor of Natural Philosophy upon his arrival in England from the United States of America, in which, upon the invitation of the most eminent scientific men of America, he has been recently delivering a series of Lectures unexampled for the interest they have created in that country, and the large and distinguished audiences who have been attracted to them.

The Members of the Royal Institution rejoice that the people of America have shared in the advantages of Professor Tyndall's teaching and illustrations of those sciences which have been so greatly advanced by the labours of his predecessors, and by his own, in the laboratories of the Royal Institution.

They receive and welcome him, on his return to what they are proud to be able to designate as his own scientific home, with satisfaction and delight, and wish him all continued health and prosperity.

The Members of the Royal Institution have also to thank Professor Tyndall for his generous gift to the Institution of the splendid and extensive apparatus employed by him in his Lectures in America, and congratulate him on the liberal spirit, and the love of science, which has led him to appropriate the profits of his Lectures in the United States to the establishment of a fund to assist the scientific studies of young Americans in Europe.

CHEMICO-AGRICULTURAL SOCIETY OF ULSTER.

ON the 7th inst., the usual monthly meeting of this Society was held in the Laboratory, Upper Arthur Street. Mr. JOHN SHARMAN CRAWFORD, D.L., presided; and amongst those present were—Mr. Wm. Charley, J.P.; Dr. Knox; Rev. Edmund M'Clure; Messrs. Samuel M'Causland, J.P.; W. Gray; F. Hodges, Chemical Assistant; J. L. Turtle; G. Glover, F.C.S. Ireland; Dr. Hodges, &c.

Analysis of Water.

Dr. HODGES said that the examination of the several specimens of water, in addition to those formerly reported, had been made. Among these was a water from Whiteabbey, which was found contaminated by sewage matters. A most interesting discovery of a water strongly impregnated with iron had been brought under his notice by the Rev. James O'Laverty, P.P. The water was contained in a pit whence gravel had been taken, in the hills above the town of Holywood, and Mr. O'Laverty kindly accompanied his son to the locality, and assisted him in obtaining specimens. It had a strong chalybeate taste, and was bright and sparkling, and an analysis of it, made by his son, showed it to contain iron equal to 14 grs. of peroxide of iron per gallon. He was not aware of any water in Ireland which contained so large an amount of iron. At present the water was diluted by the entrance of surface water, and it would be desirable to exclude this water before making a complete analysis.

Carbolic Acid as a Remedy in Cattle Disease.

Dr. HODGES read a letter received from Mr. Bloomfield, steward to Sir Edmund Macnaghten, Bart. :—

"To Professor Hodges, Belfast.—Sir, I consider you would confer a great benefit on the farmers of Ulster if you would make known your opinion as to the best mode of administering carbolic acid to young cattle suffering under a very painful and sometimes fatal disorder. I am induced to apply to you, having read an article in the last number of the *Journal of the Chemico-Agricultural Society*, wherein it is stated—'Destroying septic germs and preventing their formation, the administration of carbolic acid is evidently indicated in those diseases in which tissue change is unduly violent." As land-steward to Sir Edmund Macnaghten, Bart., I have been in the habit for nine years past of rearing annually from twenty-five to thirty calves. On being turned out to grass, and milk withdrawn from them, they have been always attacked, except in the year 1870, by a severe and infectious cough about the first week in August. None of them escaped it. Those in the lowest condition, of course, were the greatest sufferers, and several died. There need be no doubt but the seat of the complaint was the windpipe, and that from thence it passed on to the lungs. In every case where there was death, and an examination took place afterwards, the animal appeared to have been suffocated by an accumulation of minute worms, which were found in such quantities as completely to prevent breathing. The cough was only an effort to dislodge the intruders. How their entrance was made was uncertain; but the absence of them in the one year (1870) out of nine, pasture and other things having been the same in all years, would indicate that the origin of the disease was in some degree, if not entirely, owing to atmospheric influence. Many farmers in this part of the country have sustained similar losses. If you think the pest can be prevented or extirpated by carbolic acid, I would request you to state the mode in which it ought to be administered, and the quantity to be given; whether internally, or by outward application to the mouth and nostrils, or by inhalation?—I am, Sir, your obedient servant, WILLIAM BROOMFIELD, Dundarave, Bushmills, Jan. 20, 1873."

In reference to the mode of administering carbolic acid, the mixture described in the last number of our *Journal*

might be employed. It may also be dissolved in 30 parts of water, and applied to the throat by means of a piece of sponge tied on a rod; but, probably, the best mode of using it, in cases like those described by Mr. Bloomfield, would be to mix it with 50 parts of water, and to apply it in the form of spray, by means of the little spray-producing apparatus used for distributing perfumes. Dr. Hodges exhibited the spray-producer, and explained the mode of using it.

The New Patent Safety Cheque.

Dr. Hodges exhibited a specimen of the form in which his patented cheque was prepared for the use of the Ulster Bank. He had forwarded specimens of the cheques to several distinguished chemists, and he had the gratification of receiving a letter from his friend and former teacher, Baron Von Liebig, who remarked that "the idea of employing the prepared ink, as suggested, was entirely new and excellent, and rendered the removal of writing from the cheque without detection impossible."

Oil from Shale.

Dr. Hodges said that the examination of a sample of shale had been made for R. M. Dalway, Esq., M.P., which, from the large amount of oil obtained from it, promised to yield profitable results. It was desirable that attention should be directed to the examination of the shales which are known to exist in several places in the north of Ireland. He (Dr. Hodges) regretted that he was not able to report so favourably on a specimen of rock forwarded from the neighbourhood of Toome Bridge, the bright sparkling lustre of which had led its discoverer to suppose it to contain some valuable metal. It was, however, merely a piece of crumbling mica slate, containing no precious ingredient. Pieces of rotten micaceous rock had repeatedly been sent to the Laboratory, under the belief that they were ores either of copper or gold.

The Ballintoy Coal Mine.

Mr. F. Hodges said—I beg to call the attention of the meeting to a remarkable substance which I have lately been engaged in investigating. It is obtained from the Ballintoy coal mine, where it lies just above the lignite, It resembles, as you can perceive, hardened clay in appearance; and, on being subjected to analysis, it was proved to be saturated with a very considerable quantity of hydrocarbons. This analysis, for two reasons, I consider to be of very great importance. It points, first, to the probable formation of the bed of lignite, over which it lies, by heat. Secondly, if it turned out on a further examination, to contain a workable quantity of the hydrocarbons, it would tend greatly towards the opening up of the mineral resources of the north of Ireland.

Mr. Wm. Gray said that he had brought the specimen in question from Ballintoy to have it examined by Mr. Hodges. There were several other beds of shale in the County Antrim that might be reasonably expected to yield a large quantity of oil. There were large beds in the neighbourhood of Whitehead, and the time had come when matters of this sort must be inquired into—(Hear, hear)—and it was only through a society like this that these things could be examined. He had, however, found that people were more anxious to expend money on a hopeless project than upon one which gave reasonable hope of success.

Dr. Hodges said that some years ago a gentleman in the neighbourhood of Donaghadee took it into his head that he had discovered coal in the neighbourhood. He (Dr. Hodges) examined the specimen sent him, and found that it was not coal at all; but the gentlemen was quite displeased, and declared that he was certain it was coal, only it wouldn't burn—(Laughter).

The Rev. Mr. M'Clure said that on the property of Mr. Nicholas Grimshaw, on Collin Mountain, a well was lately sunk, in which water of a peculiar property was found. It appears to contain a large quantity of magnesia, and is purgative in its properties.

Some conversation followed as to the medicinal springs of Ireland, especially the one at Swanlinbar, and the one at Lisdoonvarna, County Clare. The latter has been recommended by the faculty in Dublin for certain forms of disease, and the former is said to be somewhat similar to the famous spring at Harrogate.

CORRESPONDENCE.

DECOMPOSITION OF SULPHURIC ACID BY ZINC.

To the Editor of the Chemical News.

Sir,—In your correspondence column (Chemical News, vol. xxvi., p. 117) the Rev. H. Highton combats the opinion that the evolution of sulphuretted hydrogen from carbon connected with zinc, in a cell charged with sulphuric acid (first observed by him), is due to the contamination of the carbon used by iron sulphides; and he suggests, in explanation of this evolution, that the sulphuric acid is decomposed under these circumstances, and the gas in question thus formed.

Neither of these views appearing tenable to me, I beg to offer a few remarks thereon.

The evolution of gas instanced admits, I think, of adequate explanation in manner as follows, if we assume only this—that the carbon used in the experiments referred to had had some little contact with the atmosphere prior to use. In such a case, as is well known, the carbon will absorb a small quantity of sulphuretted hydrogen, and this *should* be evolved as such from its surface when the carbon is connected voltaically with zinc in sulphuric acid, precisely in the same manner that metallic sulphides generally—when similarly connected with zinc in the same acid—give off this gas at their surfaces, as shown in a paper of mine (Chemical News, vol. xxiii., p. 291).

In support of this, experiment will show that the gas in question does not appear if carbon free from sulphur is used; but, on the other hand, if it is sulphurised (*i. e.*, had contact with HS), then thoroughly washed, and connected with zinc in hydrochloric acid (pure), an abundance of HS is discharged from the carbon. Coke or graphite may be nearly or quite purified from sulphur in this manner, and I would recommend the process to those desirous of effecting this.

That carbon as *coke graphite* is a true metal appears, no doubt, highly probable to those chemists who consider its conducting power for heat and electricity. I can therefore see nothing improper in viewing the absorption of sulphuretted hydrogen by this substance as a chemical act, resulting in the production of an inferior sulphide analogous to the sulphuretted gold and platina I have described in your periodical, and so capable of disintegration by the same means as are generally serviceable for that of other metallic sulphides.—I am, &c.,

William Skey.

Wellington, New Zealand.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, February 24, 1873.

Contains the following original memoirs more particularly relating to chemistry:—

Researches on the Gases Dissolved in Molten Cast-Iron, Steel, and Wrought-Iron at Welding Heat.—L. Troost and P. Hautefeuille. The first instalment of a monograph treating on the nature and mode of absorption of gases (the same as those present in the reduction zone of the blast furnaces) by the metals alluded to when kept at high temperatures, and free from contact of air. In this portion of the essay, the authors particularly call attention to the gradual absorption of silicium by these metals, due to the action (corrosion) of the metals upon the silica of the crucibles—made of *gaize*, nearly pure silica, a mineral largely met with in France—when kept, viz., the metals in molten state, under strong pressure by means of oxide of carbon.

Combination of Sugar with Chloride of Potassium.—Ch. Violette.—Cane sugar forms with chloride of potassium a well-defined crystalline compound which is crystallographically described, while its chemical composition is $C_{12}H_{20}KClO_{11}$; the formula of the sugar is, therefore, $C_{12}H_{22}O_{11}$, and the combination of sugar and chloride of sodium is $C_{12}H_{20}NaClO_{11}$. This compound was discovered years ago by Peligot. The sucrate of chloride of potassium is not deliquescent.

Solidification of Mixtures of Water and Acetic Acid.—E. Grimaux.—This paper, illustrated by a diagram, treats on the point of congelation of mixtures of water and acetic acid in various proportions. The pure acid employed in these researches became solid at 14·4°, and contains, according to Rüderdorff's tables, 1·25 per cent of water. A lengthy tabulated form containing the results of the experiments is added here. A mixture of 83·79 water and 16·21 acetic acid solidifies at 5·43°, the average of three determinations.

Sensitiveness of the Bunsen Gas-Burner Flame for Boracic Acid.—M. Bidaud.—The author minutely describes a series of results of experiments, from which it appears that when the flame is, without the use of blowpipe, brought near to a piece of porcelain whereon a minute crystal of boracic acid is placed, the flame is intensely green-coloured. Even with a solution only containing 9-10ths milligrm., of the acid the colouration is strongly marked. By accurate experiments the author ascertained that the colouration was *not* due to the combustion of the copper of the alloy (brass) of the tube from which the flame issues.

Action of Zinc upon Chloride of Acetyl.—D. Tommassi and G. Quesneville.—After briefly referring to the late Gerhardt's researches on this subject, the authors state that they prepared the acetylide—as they call the result of the reaction alluded to—which is an amorphous, yellowish-brown coloured substance, soluble in alcohol, ether, chloroform, hydrochloric, fuming nitric, and anhydrous acetic acids, burning when ignited upon platinum foil with a bright flame. Dried at 100° and analysed, the composition of this body is found to be $C_{16}H_{18}O_4$. The reactions by which this body is formed are elucidated by a large number of complex formulæ.

Analysis of Agaricus Fœtens.—Dr. Sacc.—This poisonous mushroom, gathered in dry weather in a forest under oak trees, was found to contain percentically—Water, 67·20; mannite, 0·60; pectic acid, 0·09; fibrine, 4·66; bassorine, 1·55; woody fibre, 20·09; fatty and colouring matter, 0·68; ash, 5·13; total, 100·00.

Valuation of the Saccharine Matter in Beetroots.—E. Monnier.—The author states that in order to ascertain the quantity of absolutely uncrystallisable sugar which beetroot will yield, it is required to estimate the ash (saline matter) very accurately, and to multiply the figure so obtained by 4 or 5, the latter being the highest coefficient.

Rendering Ladies' Dresses and other Wearing Apparel Unimflammable.—M. Trémaux.—The author advocates the use of mixtures of sulphate of potassa and alum in solution, to be concentrated according to the nature of the fabric it is intended to render—not as is sometimes erroneously supposed incombustible, but uninflammable.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 5, 1873.

Contains the following original memoirs and papers:—

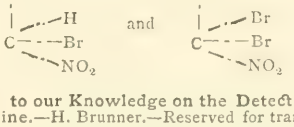
The Atomic Weight of the Cerium Metals, and on the Salts of the Protoperoxide (Ceroxydoxydul) of Cerium.—C. Rammelsberg.—This monograph, elucidated by a large number of complex formulæ, treats on the composition of the salts of the protoperoxide of cerium, Ce_3O_4, but according to Mendelejeff (who takes the equivalents of cerium at 138, two-thirds more than the former equivalents, viz., 92) CeO_2, while the protoxide of cerium then becomes Ce_2O_3, formerly CeO. The salts alluded to are described at length, and the essay contains an exhaustive discussion on the atomic weights of the other metals of the cerium group, viz., didymium, lanthanum, yttrium; &c.

Spontaneously Inflammable Phosphuretted Hydrogen Obtained from Iodphosphonium.—C. Rammelsberg.—The author briefly observes that the gas obtained from iodphosphonium by the action of caustic potassa is not spontaneously inflammable (see *Ber. d. Deutsch. Chem. Gesells.*, 1871, p. 200), but becomes so while being evolved, and this is confirmed by an observation made by H. Rose (*Pogg. Ann.*, 24, p. 345).

Sensitiveness for Light of the Haloid Salts of Silver when Developed (in Photographic Sense) by Alkalies.—H. Vogel.—The main features of this essay may be summarised as follows:—The photographic sensitiveness of the chloride. Bromide and iodide of silver is not simply affected by the intensity of the light, but is essentially modified by the method of development. For acid developers and white light the scale is—Iodide of silver>bromide of silver>chloride of silver (the sign > signifies here "more sensitive than"). For alkaline developers—Bromide>chloride>iodide. With coloured light (that is to say when violet and indigo are wanting) and alkaline developers the same scale holds good. For acid developers and dry plates the scale is iodobromide (iodbromsilber)>bromide>iodide of silver. With the wet process and acid developers the most sensitive mixture is (5AgI+1AgBr); but with the dry process a mixture rich in bromide answers best. The method of preparation does not, according to my researches, affect the sensitiveness of the three haloid salts of silver alluded to.

Constitution of Hyperiodic Acid.—A. Basarow.—The contents of this memoir bear chiefly upon certain corrections which the author thinks are required to be made in Dr. Thomsen's essay on hyperiodic acid, recently published in *Berichte der Deutschen*, vol. vi., p. 2; and further we meet here with the author's theoretical views on the constitution of the acid.

The Nitro Compounds of the Fatty Series (Fifth Part).—V. Meyer and C. Wurster.—This essay is divided into the following sections:—Monobrom-nitroethan; dibrom-nitroethan. The first-named is an oily liquid, boiling at from 145° to 148° without decomposition; formula $C_2H_4BrNO_2$. This body is acid, which forms with some of the alkalies crystalline salts, but in most instances a further decomposition sets in. The dibrom-nitroethan has not acid properties, is an oily fluid boiling at between 162° and 164°; the constitutional formulæ of the bodies alluded to are respectively—



Contribution to our Knowledge on the Detection of Digitaline and Atropine.—H. Brunner.—Reserved for translation.

Conversion of Glycerine into Aceton.—O. Lange.—In the first part of this paper the author refers to the labours of Carius (*Ann. Chem. Pharm.*, 155, p. 35) on this subject, and then relates at length the results of his experiments for converting crystalline dichlorbrom-aceton into aceton by the action of granulated zinc and some sulphuric acid; the boiling-point of the aceton is 58°. This reaction, however, is very slow; it is elucidated by the following formula:—

$$C_3H_2Cl_4Br_2O + H_{10} = C_3H_7Br + BrH + 2ClH + H_2O.$$

The aceton was, in order to ascertain its identity, combined with bisulphite of soda, the composition of that combination led to the formula $C_3H_8O.SNaHO_3$.

A new Body of the Same Composition as Hydrocyanic Acid.—O. Lange.—This essay records at length the results of an investigation of the slow reaction (continued for several months) of epichlorhydrine and hydrocyanic-anhydride placed together in equal parts in sealed tubes, and exposed to sunlight. After a lengthy process of purification, the author obtained a crystalline body, readily soluble in water and in boiling alcohol, but difficultly soluble in ether. When heated by itself it detonates, giving off a smell of hydrocyanic acid, while by being heated with water the substance is decomposed, depositing a humus-like substance. The formula of this new body is CNH; percentically, C, 44·44; H, 3·70; N, 51·8.

The Systematic (Systematik) of Inorganic Chemistry.—L. Meyer.—Elucidated by a large number of formulæ and tables. This essay, bearing upon the theory of chemistry, is not suited for abstraction, notwithstanding its high intrinsic value.

Activity of Oxygen in the Processes of Slow Oxidation.—H. Fudakowski.—Reserved for translation.

Chloral and Acetonitrile.—H. Hübner.—After briefly referring to Bayer's researches on the reaction of chloral, benzol, and sulphuric acid, resulting in the formation of the compound $C(C_6H_5)_2H.CCl_3$, the author describes at length, and elucidates, by a series of complex formulæ, the results of his researches on the reaction between chloral and acetonitrile, whereby a peculiar amide of a bibasic chlorinated acid is obtained.

Action of Sulphocyanates upon Benzoic Acid.—A. Kekulé. This essay reviews chiefly the results of the researches on this subject obtained by Pfankuch (it is especially pointed out that the benzacrylic acid obtained by this author, for which see *Journ. f. Prakt. Chem.*, N.F., vol. xi., p. 97, does not exist), Kachler, Williams, Letts, Purper, and others.

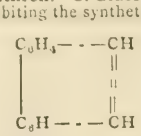
Action of Cyanide of Potassium upon Chloral, and on a New Method of Preparing Dichloracetic Acid.—O. Wallach.—At great length the author describes, first, the method of preparation of chloral-cyanhydrate, obtained by the action of 1 molecule of cyanide of potassium upon 1 molecule of chloral-hydrate in small quantity; while the reaction yields, in large quantity, dichloracetic acid ether, which, by treatment with HCl at 150° in a sealed tube, is readily converted into chlorethyl and dichloracetic acid, which may thus be readily prepared.

New Series of Aromatic Hydrocarbons.—Th. Zincke.—The third instalment of a monograph on this subject. This portion treats on the hydrocarbons formed by the action of zinc powder upon a mixture of benzol and benzyl-chloride.

On Griess's Phenylen-diamine, and on Bibrom-benzol.—Th. Zincke and Fr. Sinteris.—The authors state, in the first place, that the brom-nitrobenzol, fusing at 38°, may be readily converted into Griess's phenylen-diamine by first converting the aforesaid brom-nitrobenzol into the thereto corresponding nitraniline, and next treating that with tin and hydrochloric acid. So obtained, the

phenylen-diamine was a crystalline body, fusing at 99°, soluble in ether and chloroform, and yielding, with perchloride of iron, the reaction alluded to by Griess. The second portion of this lengthy essay treats on bibrombenzol, more especially on its position, viz., whether it is 1·4 or not.

Synthesis of Phenanthren.—C. Graebe.—Elucidated by a series of complex formulæ, exhibiting the synthetical formation of phenanthren—



Chemical Nature of Staurolithe.—C. Rammelsberg.—After first quoting the results of former researches of this mineral, the author states that staurolithe from Gotthardt consists, in 100 parts, of—Titanic acid, 0·56; silica, 29·46; alumina, 52·29; protoxide of iron, 13·42; magnesia, 2·29; water, 1·42; total, 99·42. Simplest formula—

$$H_2R_3Al_6Si_6O_{34} = R_{22}Si_3O_{17}.$$

Synthesis of Tyrosine.—A. Ladenburg.—Illustrated by woodcuts. Treats on Barth's experiments made with tyrosine, and on its rational formula, and on its synthetical preparation.

Constitution of the Chlorophenols, the Chloronitrophenols, and the Nitrophenols.—A. Faust.—Elucidated by lengthy and complex formulæ, as well as several tables. This memoir treats exhaustively on—Metachlorpara-nitrophenol, fusing-point 110°; metachlormeta-nitrophenol, fusion-point 70°; metachloroparanitrometa-nitrophenol, fusing at 110° to 111°; dimetachloropara-nitrophenol, fusing at 125°; parachlorometa-nitrophenol, fusing at 86° to 87°; parachlorodimeta-nitrophenol, fusing at 81°; parachlorometanitrometachlorophenol, fusing at 121° to 122°.

Action of Zinc upon Mixtures of the Aromatic Haloid Combinations and Aromatic Hydrocarbons.—Th. Zincke.

Direct Formation of the Aromatic Amido-Derivatives.—H. Salkowski.—The conclusion of an essay on this subject.

Les Mondes, February 27, 1873.

Crucibles of Great Resistance.—M. Lemagnent.—Without entering into particulars concerning the mode of manufacture, or the nature and properties of the ceramic paste of the crucibles supplied by the author, it appears that by practical experience these vessels are superior to any other, bearing as they do without any great deterioration, from 25 to 30 castings. The authorities of the French naval dockyard foundries speak in very high terms of these crucibles.

Barometrical Table for the use of those who Ascend in Air-Balloons.—M. de Lagorge, C.E.—The tabulated form here published indicates for from 100 to 100 metres, viz., 100, 200, 300, and so on to 10,000, the reading of the barometer in millimetres corresponding to these altitudes. This table may readily also serve for determining the height of mountains.

La Revue Scientifique de la France et de l'Etranger, March 1, 1873.

Contains no papers relating to chemistry, but attention is called to the following papers:—

Classification of the Human Races.—Baron D'Omalius d'Halloy.

Unity of the Human Species.—Professor Quetelet.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 243, March, 1873.

Contains the following original papers relating to chemistry and collateral subjects:—

Reports on the Ready-Made and Mixed Vitrifiable Pigments for Staining Glass and Porcelain, as Prepared by Lacroix.—J. Salvetat.—The contents of this paper relate to the mode of preparation of the mineral pigments used in staining glass and porcelain, and mixed ready for immediate use, being preserved in tin tubes akin to those used for artists' colours.

Presence of Phosphorus (Phosphoric Acid) in the Ashes of Coals and Coke.—Le Chatelier and L. Durand Claye.—The contents of this paper, elucidated by numerous quotations of results of analysis of coal-ash published in various treatises on metallurgy and on geology and chemistry, bear more particularly upon the fact that by the presence of phosphoric acid, which varies in quantity from 0·20 to even 3·01 per cent. in coal-ash, phosphorus is introduced into crude cast-iron, as well as into the iron castings made in foundries.

The Great Salt-Mines of Poland; and the Gypsum-, Sulphur-, and Petroleum-Bearing Strata of that Country and Galicia.—E. Heurteau.—The first instalment of an exhaustive report on these matters as the result of a lengthy visit to the localities alluded to.

Although not belonging to chemistry attention is called to the following memoir:—

Report on Donnet's Improved Machinery for Forcing into the Soil the Iron Tubes used for the So-called Norton or Tube Wells.—M. Tresca.—Illustrated with engravings.

PATENTS.

Communicated by Messrs. Vaughan and Son, Patent Agents, 54, Chancery Lane, London, W.C., and 8, Houndgate, Darlington.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

495. W. C. Nangle, Bull Point, near Devonport, Devon, "A new or improved composition or paint, to be used for coating metal and other substances."

505. H. Deacon, Widnes, Lancashire, "Improvements in the manufacture of chlorine."—Petitions recorded February 11, 1873.

511. S. W. Maquay, Dublin, "An improved process to be employed in the manufacture of manures, and machinery or apparatus therefor."

513. H. Campbell, Queen Anne Street, Middlesex, "Improvements in the manufacture of manure, and apparatus therefor."—Petitions recorded February 12, 1873.

539. J. Noad, Hackney Wick, Middlesex, "Improvements in the manufacture of sulphurated lead, in apparatus therefor, and in its application to various useful purposes."—Petition recorded February 13, 1873.

547. J. G. Willans, Bayswater, Middlesex, "Improvements in the manufacture of iron and steel."

551. D. Hutchison, Mile End, and W. G. Bridges, Stepney, Middlesex, "An improved composition for removing and preventing incrustation in boilers."—Petitions recorded February 14, 1873.

562. T. A. Rochussen, King William Street, London, "Improvements in the manufacture of iron and steel, and in apparatus employed therein."—A communication from R. Daelen, Neuss, Germany.

567. R. Cockshott, Bradford, Yorkshire, "A new or improved oil or lubricant."

569. J. Patison, Airdrie, Lanarkshire, N.B., "Improvements in the destructive distillation of coal and shale for the production of illuminating gas, fuel, and oil, and other products therefrom, and in the apparatus therefor."

570. H. Y. D. Scott, C.B., Ealing, Middlesex, "Improvements in the deodorisation of excreta, and in the manufacture of manures therefrom."—Petitions recorded February 15, 1873.

588. A. J. H. Hutchings, Bristol, "Improvements in spicing and preparing malt or distilled vinegar, rendering the same better suited for pickling purposes."—Petition recorded February 17, 1873.

599. C. W. Sutton, Stowmarket, Suffolk, "Improved combinations of ingredients for removing acidity from ales, beers, porters, wines, &c., and also to preserve them from acidity."

607. G. Noble, Woodford Bridge, Essex, "An improved method of treating fibrous materials for the manufacture of pulp for paper."—Petitions recorded February 18, 1873.

642. W. G. Martin and R. E. R. Martin, Hemingstone Hall, Suffolk, "Improvements in the manufacture of artificial fuel."—Petition recorded February 20, 1873.

NOTICES TO PROCEED.

3040. P. Maccallum, Dunfermline, N.B., "A new or improved artificial fuel."—Petition recorded October 15, 1872.

3142. A. V. Newton, Chancery Lane, Middlesex, "Improvements in furnaces for burning sulphurous ores."—A communication from K. Walter, Augsburg, Bavaria.—Petition recorded October 23, 1872.

3194. T. Colby, Dunstable, Bedfordshire, and J. E. Poynter, Glasgow, N.B., "Improvements in obtaining caustic baryta."—Petition recorded October 28, 1872.

3412. G. Alsing, Preston, Lancashire, "Certain improvements in the treatment of night-soil and other refuse matter."—Petition recorded November 15, 1872.

274. R. H. Patterson, Hammersmith, Middlesex, "Improvements in the purification of coal-gas, and in the production of alkaline sulphides to be employed for such purpose."—Petition recorded January 23, 1873.

370. J. Richardson and J. Watson, Gateshead-upon-Tyne, Durham, "Improvements in puddling and rolling-mill furnaces."—Petition recorded January 30, 1873.

429. J. P. Sharp, Birmingham, "Improvements in the manufacture of steel, and in case-hardening, or partially converting iron into steel."—Petition recorded February 5, 1873.

458. A. Lafargue, Westbourne Park, Middlesex, "Improvements in the production of gas or vapour from hydrocarbon oils or combinations thereof with other matters, and in means or apparatus employed in utilising the same."—Petition recorded February 7, 1873.

PATENTS SEALED.

2573. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of hydrochloric acid, and in apparatus employed therein."—Dated August 29, 1872.

2596. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of salt."—Dated August 31, 1872.

2630. J. W. Pollard, Mincing Lane, J. Schofield, Mark Lane, and A. Butel, Merchant Street, Bow, Middlesex, "Improvements in the treatment of spent oxides of iron for the purpose of extracting cyanides."—Dated September 4, 1872.

2649. W. Meister, E. Lucius, and A. Brüning, Hoechst, near Frankfort-on-the-Main, Germany, "Improvements in the manufacture of colouring matter suitable for dyeing and printing."—Dated September 6, 1872.

2790. R. Stone, Liverpool, "An improved artificial fuel."—Dated September 28, 1872.

2801. J. McDougall, Manchester, "Improvements in the manufacture of manures."—Dated September 21, 1872.

3192. E. P. H. Vaughan, F.C.S., Chancery Lane, Middlesex, "Improvements in the mode of, and apparatus for, generating gas for lighting and heating purposes."—A communication from E. A. Dubois, Paris.—Dated October 28, 1872.

3968. G. T. Bousfield, Sutton, Surrey, "Improvements in the manufacture of steel, and in apparatus employed for this purpose."—A communication from T. R. Scowden, Cincinnati, U.S.A.—Dated December 31, 1872.

MEETINGS FOR THE WEEK.

MONDAY, March 10th.—Medical, 8.
—— Royal Geographical, 8½.
—— London Institution, 4.
TUESDAY, 11th.—Civil Engineers, 8.
—— Photographic, 8.
—— Royal Institution, 3. Prof. Rutherford, "On Forces and Motions of the Body."
WEDNESDAY, 12th.—Society of Arts, 8.
—— Geological, 8.
THURSDAY, 13th.—Royal, 8½.
—— Royal Society Club, 6.
—— Royal Institution, 3. A. Vernon Harcourt, M.A., F.R.S., "On the Chemistry of Coal and its Products."
FRIDAY, 14th.—Royal Institution, 9. Prof. Allman, "On Coral-Reefs and their Architects."
—— Astronomical, 8.
—— Quekett Microscopical Club, 8.
SATURDAY, 15th.—Royal Institution, 3. Prof. W. K. Clifford, M.A., "On the Philosophy of the Pure Sciences."

TO CORRESPONDENTS.

A Bookkeeper.—See article on "Luminous Fountains," vol. xxi., p. 231.

M. and S.—You will find particulars in recent numbers of the CHEMICAL NEWS, under "Chemical Notices from Foreign Sources."

Volta.—(1). Boiled linseed oil. (2). Borate of manganese with raw linseed oil. (3). At the manufactory or of the agent.

Student.—Your letter has been sent to the proper quarter.

S. A. S.—We have none at present.

A Subscriber.—(1). It is in French. (2). Probably.

Alpha.—(1). Read Mr. Lowthian Bell's work (CHEMICAL NEWS, vol. xxiii., p. 104). (2). Yes, any bookseller will get it.

P. J.—Yes, but it is rare.

R. F.—Advertise for the information.

A. Esilman.—In our next.

BOOKS RECEIVED.

A Manual of Metallurgy. By George Hogarth Makins, M.R.C.S., F.C.S. Second edition. Ellis and White.

Proceedings of the American Pharmaceutical Association; Twentieth Annual Meeting. Philadelphia: Sherman and Co.

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THE CHEMICAL NEWS.

Vol. XXVII. No. 694.

ON THE VAPOUR-DENSITY OF POTASSIUM.

By JAMES DEWAR and WILLIAM DITTMAR.

Preliminary Notice.*

Since the elaborate experiments of Deville and Troost on the vapour-densities of substances at high temperatures, little has been added to chemical science in this field of research. Doubtless this is in great part owing to the difficulty of any *one* student manipulating the complex apparatus necessary for the execution of the experiments. But the operations are greatly increased in difficulty, when we select bodies that are readily inflammable in air and attack with facility glass and porcelain at the high temperatures to which they are exposed. This is the reason why the molecular weights of a most important class of elementary bodies, viz., the *Alkali-metals* (although these are volatile at moderate temperatures), have remained to the present time undetermined. It was with the view of adding something to our knowledge in this department that we recently undertook some experiments with potassium, the results of which we now beg leave to lay before the Society. The special difficulties we had to overcome are involved in the endeavour to answer the following questions:—

1. Is it possible to convert potassium into a gas of one atmosphere's pressure at any of the *constant* temperatures we can at present command?
2. Is it possible to generate *pure* potassium-vapour, and to keep it from getting oxidised?
3. Supposing a definite volume of such vapour to have been procured, how can its *weight* be ascertained?

After a succession of failures, which we shall not detail, we at last succeeded in devising a workable process, which may be briefly described as follows:—

A cylindrical iron bottle, of at least 200 c.c. capacity, of a thickness in the body ensuring sufficient rigidity at even a bright red-heat, and provided with a well-ground inbent neck, pierced with a canal of about 2 m.m. in diameter, is employed as a generator and receptacle of the vapour.

A mass of about 20 kilos. of zinc, contained in a plumbago crucible, which, being placed in a forge-fire, can be readily heated up to the boiling-point, serves as a bath.

The experiment begins by first deoxidising the inside of the receptacle, at a red-heat, by means of a current of dry hydrogen, which is continuously maintained until the bottle has cooled down below redness. At this stage about 200 grms. of pure mercury are introduced into the bottle, which is then inserted into the red-hot zinc, without, however, covering the upper extremity of the bottle. After three-fourths of the mercury is distilled off (which is accomplished in a very short time), the neck is withdrawn, and while the mercury vapours are still streaming out, an iron test-tube, previously prepared with great care and charged with 4 to 5 grms. of potassium, is dropped into the bottle, the neck re-inserted, and, after the *whole* of the bottle has been immersed into the zinc, the blast of the forge forcibly increased, so as, in the shortest possible time, to bring the zinc into the state of boiling, proper arrangements being made for keeping the neck of the bottle red-hot. The potassium in a short time begins to volatilise, issuing in jets into the air, and depositing caustic potash at the nozzle, which must be kept clear by means of an iron wire. As soon as the distillation of the potassium ceases, the nozzle is closed by means of a ground-in wire plug, at once immersed into a mass of mercury, contained in a test-tube, and the bottle withdrawn to a proper support, on which it is allowed to cool.

After it has reached a manageable temperature, the bottle is inserted into a mass of recently boiled water, the wire plug withdrawn, and the hydrogen formed by the action of the water on the potassium pumped out by means of a "Sprengel" into a eudiometer, to be measured.

In the experiments we have hitherto carried out, we have satisfied ourselves that the amount of mercury vapour *not* swept out by the potassium is quite inappreciable; and as our object has been in the meantime to merely arrive at approximate results, and to perfect our methods of manipulation, we have neglected the minute correction which—on account of that small remnant of mercury—ought, strictly speaking, to have been applied to the volume of the vapour as calculated from the capacity of the bottle in the cold, the coefficient of expansion of iron, and the temperature (1040° Deville) at which the vapour was measured.

The results of our observations conclusively show that the density of potassium vapour, as produced in the process described, cannot exceed 45 times that of hydrogen, and that therefore the molecule of potassium consists of *two atoms* (K_2).

We intend to prosecute our research in other directions, proposing to ascertain, if possible, the densities of the *iodides* of cæsium, rubidium, and potassium, these being, according to Bunsen's experiments, the most volatile of the haloids of the alkali-metals.

* A Paper read before the Royal Society.

SEPARATING GOLD FROM ARGENTIC CHLORIDE.*

By ADOLPH LEIBIUS, Esq., Ph.D.,
Senior Assayer of the Sydney Branch of the Royal Mint.

In refining argentiferous gold by means of chlorine gas (Miller's patent), the silver is eliminated in the form of chloride of silver, or, as now termed, argentic chloride.

In the paper read by Mr. Miller before this Society, on December 1st, 1869, he described this process so fully that I need not refer to more of it than that part which speaks of the argentic chloride produced. This argentic chloride is never pure, but contains, besides chloride of copper, a considerable quantity of gold, stated by Miller, in the paper quoted above, as 2 per cent of the gold previously refined. If this auriferous argentic chloride is reduced to metallic state without freeing it of its gold, silver bullion results, containing from 12 to 20 per cent of gold, the average being about 18 per cent. This gold exists chiefly in combination with chlorine, and also as a double compound of chloride of gold and silver. By melting the chlorides in a boraxed clay pot, with from 8 to 10 per cent of metallic silver, the greatest part of this gold was removed, but never the whole. Miller states that, with proper care, the amount of gold remaining in the silver need not exceed 3 parts in 10,000. While such was the case in many instances during the time the experiments were going on, the amount of gold left in the silver bullion produced varied from 3 to 27 parts in 10,000, the average being 13 parts in 10,000. Lengthy experience obtained since has shown that, when working on a large scale, and therefore with less time at disposal than when engaged in experimental trials only, the results became still more variable, the gold in the silver bullion having been not seldom as much as 100 to 150 parts in 10,000, and often 10 to 40 parts in 10,000. This irregularity in the results obtained made it desirable to institute further experiments with a view of arriving at a method which

* Read before the Royal Society of New South Wales, November 20th, 1872.

would, if possible, take out all the gold, or at all events would only leave a minute and regular proportion of this metal in the silver bullion produced. To free the silver bullion from gold by dissolving it in acid would, in the Colony, where acids are very expensive, not be found remunerative, especially as silver bullion containing 5 grs. of gold per lb. troy can be more advantageously sold in London. When the auriferous argentic chloride is merely fused in a boraxed clay pot without any addition of silver or anything else, about 60 per cent of the gold therein is separated, while about 40 per cent remains in combination with the argentic chloride.

In the use of metallic silver, which was employed in strips about ⅛" thick, the silver thus added acts decomposing upon the gold compounds, forming chloride of silver, at the expense of the chlorine formerly in combination with the gold. The silver had to be in contact with every part of the molten chloride, which was, as much as possible, achieved by stirring the same with the silver strips employed. Was the heat of the furnace a little too great, and thus allowed the silver strips to melt too rapidly, the silver sank to the bottom of the pot with only a portion of the gold, producing a silvery gold button, while more or less gold was left in the liquid chloride. This, no doubt, was the chief cause of irregularity in the results obtained by employing silver strips. But, even had this not been so frequently the case, a considerable objection to its use would always have been the fact that a large amount of metallic silver would annually have been converted into argentic chloride, and back again into metallic silver.

To avoid this addition of metallic silver, and to substitute other reducing agents, a series of experiments was instituted; fusion, with addition of argol and of resin, as well as reduction by means of hydrogen gas, and also coal-gas, were successively tried; the results have, however, not been found sufficiently practicable.

The addition of carbonate of soda promised more success. Indeed, during the experiments carried on in the Sydney Mint in 1868-9, conjointly with Mr. Miller, by Mr. Hunt and myself, to test the applicability of the refining process on a large scale, the employment of soda for freeing the argentic chloride from gold was suggested by me; but only one trial was made, and, not having been carried out with the precaution which I now found to be required, a considerable loss in the operation caused its rejection in favour of the before-mentioned metallic silver strips. When soda is added in powder to fused chloride of silver, the action ensuing is very violent, and this causes a spitting and throwing up of metallic silver, thereby causing great loss; but when the fused chloride is covered with a layer of borax one-eighth to one-quarter inch in thickness, and the soda is gradually introduced on the top of this layer of borax, the action is found to be very gentle, and can easily be regulated. The quantity of soda required may vary from 16 to 20 ounces per 230 ounces of chloride, fused in a No. 18 boraxed French clay pot. Twenty ounces of soda produce a gold button weighing about 35 ounces, assaying from 870 to 880, while the silver bullion produced will contain from 2 to 5 parts of gold in 10,000 parts.

The operation is very regular in its results, but, as seen, not all the gold is removed thereby; in fact, in no case, even with an increased quantity of soda, was the whole of the gold removed in *one* operation. To produce silver bullion *free* from gold was, however, *always* successful when the argentic chloride was subjected to a second treatment, with about 3 ounces of soda pro 200 ounces of argentic chloride. This second operation is done similar to the first, but in a new pot, also boraxed; it requires a short time—about one hour. The argentic chloride containing only traces of gold from the previous treatment with soda, fuses much more readily than when it contains much gold. The time occupied by the first operation varies somewhat, according to the heat of the melting furnace and the character of the chloride. To fuse 230 ounces argentic chloride, after having been introduced into a red-hot pot placed inside a guard, takes from 60 to 80 minutes; the addition of the soda, from 20 to 30 minutes; after which the pot is covered, and the heat of the furnace increased to get all in good fusion, which takes from 10 to 20 minutes. The pot is then removed from the fire, allowed to cool sufficiently for the gold to solidify, when the still liquid argentic chloride is poured off into iron pans, and placed into the galvanic battery, a description of which I gave in a paper read before the Royal Society of New South Wales in December, 1869.

While the soda is being added, the top layer is occasionally gently dipped with a stirrer slightly underneath the molten chloride, without stirring the same; in fact, it is preferable not to stir the fused chloride, but to let the gold collect at the bottom of the pot, and to pour the chloride carefully off.

The presence of a large proportion of copper in the chloride has been found to prolong the operation considerably; it is therefore advisable to refine gold bullion containing much copper by itself, and to free the resulting argentic chloride, which therefore contains much copper, by dissolving the same after being reduced to the metallic state.

It is remarkable how uniformly the gold is diffused in the argentic chloride. Any portion of a slab of this chloride, free from borax, may be assayed for gold, and will be found alike. This offers a convenient means for ascertaining the result of the treatment with soda before the argentic chloride is placed in the battery for reduction. A small piece is broken off from one corner of the slab of chloride, and reduced to fine powder in a Wedgwood mortar; the powder is kept in a corked glass tube, and from thence weighed out for assay in an assay balance. Ten grains are wrapped in a piece of lead-foil 1½ inches square, and cupelled at low heat with about 60 grains of lead; the resulting silver button is boiled out, and the gold weighed.

This mode of assaying the chloride is so quick—six samples can be easily assayed, inclusive of powdering, in one hour—that it is well worth employing in all cases. Should the assay show more gold in the chloride than desirable, it must be subjected to another treatment with soda. Such a case need, however, only rarely, if ever, occur.

The question whether the *whole* of the gold should be removed from the chloride by a second treatment with soda, as described, or whether such additional expense for pot, fuel, &c., is better avoided, if silver bullion containing little gold were readily saleable, must naturally be left to the consideration of the circumstances attending each case.

DR. MORFIT'S TREATISE ON "MINERAL PHOSPHATES AND PURE FERTILISERS."

By A. ESILMAN.

I was induced since my last communication to carry out Dr. Morfit's process for the analysis of mineral phosphates on a mixture of known composition, made to represent a native impure phosphate, and in describing the details I will use his own words as much as possible. With regard to the remarks he makes in reply to mine on this point, I have simply to say that in his work he unreservedly puts forth his method as capable of distinguishing "what proportion of the phosphoric acid may belong to alumina, iron, and other bases than lime" (p. 432), and if it is at fault in this particular, on account of the backwardness of science, I think it would be better for him to do like other chemists—report phosphoric acid equal to phosphate of lime, in the full understanding that it is a method of expediency. Had this admission been made in his work it would have saved me from the trouble of making it manifest experimentally.

I made a mixture of 10 grs. phosphate of iron, 10 grs.

phosphate of alumina, 5 grs. ammonio-phosphate of magnesia, and 75 grs. bone-ash, freshly calcined. The ferric and aluminic phosphates were prepared from a solution of iron and aluminium alum respectively, mixed with excess of phosphate of soda, the precipitate re-dissolved in hydrochloric acid, and thrown down again by acetate of ammonium. This ensured the formation of phosphates of definite and normal composition, viz., Al_2O_3,PO_5 and $Fe_2O_3PO_5$. They were thoroughly washed, dried, and ignited. The ammonio-phosphate of magnesia was prepared in the ordinary way, and dried at 212°, having the composition $2MgO,NH_4O,PO_5+4HO$. The bone-ash was analysed, and gave the following results:—

	Per cent.
Tricalcic phosphate	86·48
Trimagnesic phosphate	3·62
Carbonate of sulphate of lime	9·50
Sand, &c.	0·50
	100·00

25 grs. were weighed out, dissolved in hydrochloric acid, and the insoluble separated by filtration. Dr. Morfit's prescription was now followed, and to separate the lime the requisite volume of alcohol was added, and then sulphuric acid in excess. In the book occurs the remarkable statement, "the filtrate is to be treated with pure sulphuric acid, added dropwise until it *reddens a piece of blue litmus paper dipped into it.*" The quantity of sulphate of lime thus obtained agreed very closely with the lime estimation by oxalate of ammonium.

The filtrate and washings were now gently evaporated to concentrate and expel alcohol, then treated with ammonia in tolerably large excess to precipitate phosphates and oxides of iron, alumina, and magnesia. After standing all night it was filtered off, and washed with ammoniacal water. Here my difficulties began. The filtration and washings were excessively tedious, occupying a whole day; and towards the close I found the washing waters becoming coloured owing to the re-solution of the ferric phosphate in the pure ammoniacal wash-water, described in chemical treatises. This necessitated a re-filtration, and washing with ammoniacal water containing chloride of ammonium, which was successful. The solutions on being boiled again deposited ferric phosphate, however, and a third tedious filtration and washing was gone through. The filtrate and washings were evaporated, treated with ammoniacal sulphate of magnesia, and the phosphoric acid determined. This I am told to calculate to phosphate of lime, to give the quantity existing in the raw mineral.

The precipitate by ammonia was dissolved in hydrochloric acid, and excess of caustic potash added to precipitate the phosphates of iron and magnesia, and re-dissolve the phosphate of alumina. The solution after separating the insoluble was acidified with hydrochloric acid, then treated with excess of carbonate of ammonia, which precipitated alumina and phosphate of alumina. In this precipitate, after being weighed, phosphoric acid was determined, calculated to $Al_2O_3PO_5$, and the alumina obtained by difference.

The insoluble in caustic potash was re-dissolved in hydrochloric acid, a slight excess of ammonia added, then excess of acetic acid poured in. The precipitate completely dissolved, showing the absence of phosphate of iron. The liquid was then diluted with hot water, exactly neutralised with ammonia, and the oxide of iron filtered off, washed, and weighed. The filtrate and washings, said to contain phosphate of magnesia, were then evaporated to a small volume, allowed to cool, and treated with excess of ammonia; but no precipitate was obtained after 36 hours standing. In every case the precipitates and waste washing liquors were examined, and any stray ingredient estimated.

I now subjoin the actual results and those obtained by Dr. Morfit's method:—

	Actual.	By Dr. Morfit.
Tribasic phosphate of lime ..	64·86	69·82
Tribasic phosphate of magnesia	2·72	none
Ammonio-phosphate of magnesia	5·00	none
Carbonate of lime	7·12	1·94
Phosphate of alumina	10·00	8·80
Alumina	none	1·60
Phosphate of iron	10·00	none
Oxide of iron	none	6·40
Sand, &c.	0·30	0·30
	100·00	88·86

According to the above will Dr. Morfit's method give results low in phosphate of lime? Not when the iron and alumina exist mainly as phosphate, though undoubtedly when they are free the calcic phosphate will come out too low. Again, what have become of the phosphate of iron, phosphate of magnesia, and part of the phosphoric acid? The phosphate of iron in presence of phosphate of magnesia has been almost completely decomposed by the caustic potash, the insoluble being ferric hydrate, magnesia, and a trace of phosphate of iron. This accounts for the complete solution of the precipitate in acetic acid, phosphate of iron being soluble in ferric acetate. The phosphoric acid belonging to the magnesia and oxide of iron going into the potassic solution with the aluminic phosphate remains in great part soluble when the latter was precipitated by carbonate of ammonia, and was not determined by Dr. Morfit. The magnesia, in like manner, was untouched when ammonia was added to precipitate and determine phosphate of magnesia.

I, however, estimated the quantities of these stray ingredients, and give them as follows:—

Phosphoric acid in the solution from alumina and phosphate of alumina	6·14
Phosphoric acid in the oxide of iron precipitate..	1·02
Magnesia in the phosphate of magnesia solution	3·02
	10·18

This 10·18, with the ammonia and water in the 5 grs phosphate of magnesia, make up the analysis to 100·83 sum total.

Estimation of Fluoride of Calcium, p. 459.—After fusion with silicate of soda, separation of silica, he says, "The liquor is now to be treated with hydrochloric acid until it reddens blue litmus, and afterwards with a slight excess of chloride of calcium." Now, really, what is to be gained by this departure from the excellent method of Fresenius, by which any chance of incomplete precipitation of fluoride of calcium is prevented by using a slightly alkaline solution?

Similar errors pervade the methods given for the analysis of native phosphates of alumina and iron, and artificial manures. Take the analysis of Redonda phosphate, the presence of constitutional water is entirely ignored. After drying on a sand-bath, he calls the loss by ignition organic matter! Then, again, talking of the composition of native phosphates of alumina, he says (p. 506), "It may be wholly metaphosphate of alumina ($Al_2O_3,3PO_5$), or a mixture of that and pyrophosphate ($2Al_2O_3,3PO_5,10HO$) when dried at 110°, together with more or less of free alumina." Has Dr. Morfit, may I ask, proven the existence of meta- or pyrophosphoric acid in any sample of native phosphate, and if so, will he publish an account of his experiments?

If only the biphosphate of lime is to be determined in a manure, he tells you to add thin milk of lime to the aqueous solution as long as a precipitate forms; then after washing, dissolve the precipitate of phosphate of lime, alumina, and iron in hydrochloric acid, separate the lime as sulphate, and in the solution separate the alumina and iron by ammonia, and the phosphoric acid in the usual way. This gives, by calculation, the soluble phosphate.

The alumina and iron will mainly consist of phosphate, which was previously soluble, yet it will not appear in the percentage of soluble phosphate.

I think I have done enough to show the utter uselessness in many cases of his processes of analysis to effect the results intended. My only reason for criticising them so closely as I have done, is the high claim he lays for them as analytical methods. I quote from page 465 as an instance. After giving a recapitulation of the ingredients as obtained by the analysis of mineral phosphates, he adds, "The phosphoric acid is thus shown in its individual combinations, and not totalised as triphosphate of lime according to the meretricious style of '*commercial*' chemistry" (the italics and points are his).

Contrast this position with the language of his letter in the CHEMICAL NEWS, vol. xxvii., p. 114.

I have studied with much interest the two analyses of precipitated phosphate made from Navassa guano, and South Carolinian phosphate by process (B). It would have been more instructive if the iron and aluminium compounds had been classified. Their excessive proportion is greatly at variance with the statements in the book that process (B) "eliminates the iron and aluminium compounds usually present in the raw mineral phosphate, and thus delivers the phosphate of lime constituent as a pure product." (P. 238.)

It seems certainly very surprising for me to read in the letter referred to, that "it was almost impossible to adjust the ratio of pulp so as to prevent an excess of the latter" when 10 lbs. were operated upon, after statements in the book that the reaction was so delicate as to be capable of application to quantitative analysis, and that an excess of pulp could be removed "by the mere addition of some fresh liquor."

What I and others would like Dr. Morfit to show is, that ferric and aluminic phosphates and oxides, bodies so unstable (especially the phosphate) in solutions void of free acid (as the mother-liquors will be) should replace a stable definite compound like monocalcic phosphate in a solution. When any person can prove experimentally that solutions of calcic phosphate are decomposed immediately by ferric and aluminic salts, and slowly by their hydrates, it wants very strong and conclusive evidence to prove an opposite reaction.

I hope Dr. Morfit will not think me unduly fault-finding if I express my dissatisfaction even with the statement of phosphates of lime and magnesia in the two analyses referred to. In the precipitate from Navassa phosphate, the quantities of lime and magnesia are not sufficient to form dibasic phosphate with the phosphoric acid, and in that from South Carolinian phosphate, the bases are in excess of that required to form tribasic phosphate. Am I to suppose in the former case that some monocalcic phosphate is present, and in the latter, that free lime exists in the precipitate? I can *barely* believe that dicalcic phosphate might precipitate from a solution containing acid salts of iron alumina, but that a calcic phosphate even richer in base, and therefore more alkaline, than the tribasic salt, would form under those circumstances is beyond my comprehension.

The insurmountable difficulty I apprehend in the use of the pulp is its slimy, bulky nature. On the large scale it would be impracticable to manipulate, and before it could be used for either Spence's or Townsend's processes it would have to be washed free from chloride of calcium, an immense task. Again, I would call his attention to the fact that the presence of large quantities of phosphate of iron would destroy its applicability for either of these processes.

As to his remarks on the replacement of the superphosphate of the present day by precipitated phosphate, I entirely believe in its future accomplishment. There is no doubt that the latter serves all the manurial purposes of the former, and it only requires time to make the farmer believe it. In these days of dear fuel and rising wages, no process involving much manipulation will successfully compete with the present excessively simple one.

In conclusion, I may add that I think I have successfully shown that his process for the estimation of the quantity of phosphoric acid in phosphatic materials, and for the determining of its state of combination, is utterly valueless; that the methods for the determination of ammonia and nitric acid are equally unsound; and in reply to the charge of carping criticism, I will only add that if my remarks are handled in the same spirit that has actuated me in putting them forth, I will not complain. I fully admit the extreme professional sensibilities of chemists in general, and myself in particular. With regard to a method for the determination of the state of combination of phosphoric acid in minerals, I throw out the following suggestions which might serve as the basis of a correct process. By gentle ignition, ferric and aluminic phosphates are not at all altered in their degree of solubilities, while the corresponding hydrates are completely changed in this respect. By determining the iron and alumina in the raw phosphate treated with boiling dilute hydrochloric acid (say 1 of acid to 6 of water), and in the same way after gentle ignition at a low red heat, the former would give the phosphates and hydrated oxides, while the latter would represent the phosphates alone. A third determination of the total iron and alumina would furnish results for the calculation of the anhydrous oxides, and complete the series. Such data would only be of scientific interest. To the manure maker the only information desirable is the quantity which will enter into solution, and whether it exists as phosphate or oxide matters nothing so far as it exerts an action in the mixture.

I hope the little discussion raised by Dr. Morfit's work will elicit the opinions of others more qualified to speak on the matter.

Miles Platting, Manchester.

THE MANUFACTURE OF SULPHURIC ACID.*

By J. McCULLOCH.

THE production of sulphuric acid being one of the most important processes carried on in a chemical manufactory, it is of course most essential that the manager of this department thoroughly understands the process theoretically and, what is of far greater importance, practically. If this is the case, the natural consequence will be that the best possible production will be obtained with the least possible outlay both of labour and material.

As we are a society formed for the purpose of discussing manufacturing as well as analytical chemistry, I intend confining my remarks in this paper more to the practical than the theoretical details.

Many different opinions are held as to the practical working of chambers, as well as to the theoretical principles, and, as I expect there are a number here who hold a different opinion to myself on the manufacture of sulphuric acid, I hope that if this paper does not altogether meet your views, the after-discussion may be the means of eliciting some further information which will be beneficial to us all.

We will now take a glance through the process, commencing with the burning of the pyrites. This is a very important part, and requires much care and attention, as upon this chiefly depends the proper produce of SO_3. The question arises as to which is the best form of burner for burning pyrites, so as to leave the smallest possible percentage of sulphur in the pyrites-cinders. We find so many different forms and sizes of burners in use in the various chemical works, each claiming to have some special or fancied superiority, that it is difficult to decide on the form which should come into general use, yet that

* Read before the Tyne Social Chemical Society.

he size and shape of the burner has a great deal to do with its efficiency in burning the pyrites there cannot I think be the slightest doubt.

A pyrites-burner should have two chief qualifications—First, it should be large enough to take in the necessary charge of pyrites, so that they can be spread over the surface in a very thin layer; secondly, it should be small enough to enable the workman to get at all parts of it with as little trouble as possible, in order that the burning pyrites may be thoroughly opened out, thus allowing a free current of air to pass through, for the purpose of oxidising the burning sulphur as well as the metallic substances.

In some works we find the burners built in a single row—charging the pyrites on the one side, and drawing the cinders on the other. I cannot see one single advantage this burner has to recommend its adoption, as it is very expensive to build, requires more space, and is very unhandy to work.

I was told by a manufacturer, who has them in his works, that one great advantage they possess is that, by by putting the green ore in at one side and drawing the burnt ore on the other, there is no danger of the green ore getting mixed with the burnt ore and so being lost. By inaugurating a proper system of working this can be readily avoided.

There is also another style of burner, which is made very large, and is charged with from 8 cwts. to 10 cwts. of pyrites. The advantage claimed for this burner is the great saving of labour connected with it: it requires to be charged once only in twenty-four hours. Its disadvantages, I think, outweigh the advantage it possesses. A pyrites, such as the first quality of Norwegian, may be burnt, but, if an ore is introduced into them that is at all liable to scar or slag, the large burner is very objectionable. The reason is the burning ore does not get pokered up often enough; it gets into lumps, and I have known a case in which the pyrites became a solid mass, necessitating the removal of the entire front of the burner before the working could be proceeded with.

I do not think there could be anything better than the twelve hours system if the burners are not too heavily charged; the ore is pokered thoroughly every twelve hours, keeping it open and free from scars, thus causing it to burn very freely.

The draught can also be regulated to burn the pyrites properly, and I have no doubt but, with the light charge and twelve hours, the ore will be found to be much better burnt than with the heavy charge and the twenty-four hours system.

A great source of annoyance to manufacturers in making acid from pyrites is the accumulation of smalls. A number of plans have been tried to extract the sulphur, some of them with a fair amount of success, others proving quite a failure.

The system in general use at present is a furnace, commonly called a blind- or close-furnace. It is heated by a coal fire placed at one end; the flame passing between two arches descends at the end farthest from the fire, passing under the bed of the furnace, thence to the chimney. The green dust is generally charged at the end farthest from the fire, being gradually moved up to the hottest end, where it is drawn, the reason of this being that the first equivalent of sulphur is readily driven off, while the second requires an intense heat to separate it from the iron. A great objection to this system is the quantity of coal used; in some cases as much as 1 ton of coal to 1 ton of dust being required to expel the sulphur. There is also the danger of the arch of the furnace getting cracked, the consequence being that the sulphurous acid, instead of passing into the chamber where it is wanted, passes into the chimney along with the heated air from the fire, thus giving a small production of sulphuric acid on the sulphur charged into the furnace.

While at Messrs. Allhusen's I introduced a system of burning the small which has proved entirely satisfactory.

Two cast-iron plates are introduced into the ordinary pyrites-burner, the heat from the burning pyrites igniting the dust and driving off the sulphur. In a number of years' working it has been found that on an average the burnt dust does not contain more than 1 per cent more sulphur than the burnt ore, which is very satisfactory.

The burner is fitted with air-tight doors, and has a superficial area of about 17·25 feet.

The metal plates on which the dust is burnt are each 1′8″×5′2″ and about 1″ thick, resting on the brickwork at both ends and along one side. Along the front of the plate runs a flange about 3″ high, for the purpose of preventing the dust getting in among the stones while being worked. The dust-door is made in two halves, in order that it may work easier on the hinges. When a plate requires to be renewed (which, on an average, is once in six months) the half of the door that is fast is taken off, the old plate removed, and the new one put in, the entire operation occupying only a few minutes. The dust is charged with a scoop from the front, and is raked over about four times every twelve hours. A hanger of malleable iron is introduced through the arch of the burner, passing under the front of the plate, thus keeping it from sinking (as it otherwise would do) when brought to a red heat.

These burners are charged with 3½ cwts. of pyrites per twelve hours and ½ cwt. of dust. Each plate burns ½ cwt. of dust per twenty-four hours, being charged alternately. Total charge per twenty-four hours per burner, 7½ cwts. These burners give good results, and are very easily wrought and regulated.

An objection has been sometimes raised to the admission of air to chambers through the dust-burners, the air taking up the chamber space, thus causing a loss in production. I think if the blind-furnaces are closely examined, the true cause of loss will be found in the dust having been badly burnt, or an escape of sulphurous acid through the openings in the brickwork. There is a greater danger, so far as good productions are concerned, in having too little oxygen in the chambers than in having even a very large excess. I have found over a number of years' working, with and without the dust-plates, that the produce of sulphuric acid is not at all affected by the extra quantity of air admitted while charging and working the dust.

Amongst the ores most suitable for the manufacture of sulphuric acid are Mason's, Tharsis, Norwegian, and Belgian ores. The following is the composition of some of the ores which I have burnt:—

Composition.	First Norwegian.	Second Norwegian.	Mason's.	Belgian
Sulphur	46·15	38·17	49·80	45·60
Iron	44·20	32·80	42·88	38·52
Copper	1·20	1·10	2·26	*nil*
Zinc	2·10	2·32	0·10	6·00
Arsenic	*nil*	trace	0·28	trace
Lime carbonate ..	2·55	11·00	0·18	0·11
Lime sulphate	trace	*nil*	*nil*	*nil*
Magnesia carbonate..	—	1·08	—	—
Insoluble	3·20	12·20	2·94	9·00
Moisture	0·40	0·25	0·95	0·36
Total	99·80	99·82	99·39	99·59

The cinders from the above ores contained, on an average, the following percentage amount of total sulphur:—

First Norwegian.	Second Norwegian.	Mason's.	Belgian.
3·5	7·5	3·5	2·5

It will be seen that the second quality of Norwegian contains a large quantity of carbonate of lime, which militates very much against the burning of the ore. The sulphur combines with the lime, forming sulphate of lime, which, of course, remains in the pyrites-cinders, instead of going to form sulphuric acid in the chambers.

The manufacturer would best study his interests by selecting those ores containing the least quantity of lime compounds.

Some of the ores also contain more silica than others. This I have found to be not at all injurious to the burning, provided the burners are kept at a proper heat. Most ores when burned at a high temperature "scar;" it has, however, been ascertained that the scar itself contains very little sulphur, but it is well to prevent this, as there is the danger of the scar enclosing pieces of raw ore, and also stopping the proper current of air through the burning pyrites.

Sulphur, as is well known, on being burned in air is converted into sulphurous acid, a larger quantity of air being required for pyrites as compared with free sulphur, owing to the metals contained in pyrites absorbing oxygen to form oxides. The sulphurous acid passes into a flue in connection with the burners, in which are placed cast-iron vessels containing nitrate of soda and sulphuric acid, the heat of the gas decomposing the nitre, forming bisulphate of soda and nitric acid gas. The two gases react on each other, forming sulphuric acid and binoxide of nitrogen, the latter absorbing two equivalents of oxygen from the air, forming hyponitric acid, which is again acted on by the sulphurous acid, and thus acts as a carrier of oxygen from the air to the sulphuric acid. An excess of nitrous compounds or available oxygen must be always present, so that the whole of the sulphurous acid may be oxidised. A sample of nitrate of soda taken from the nitre-pots contained as follows:—

$NaOSO_3$	82·25
$HOSO_3$	17·15
Iron and alumina..	1·30
Moisture	0·24
Total	100·94

Various opinions exist as to the reaction going on in the chamber; in fact almost every chemist who has investigated the subject takes a different view. The most simple theory which many chemists hold is the following:—

First .. .. $3SO_2+NO_5=3SO_3+NO_2$
Second .. $NO_2+O = NO_4$
Third.. .. $2SO_2+NO_4=2SO_3+NO_2$

The nitrous compounds are, as will be seen, ultimately reduced to NO_2, after which it plays the part of carrier between the O of the air and the SO_2.

The agents, therefore, that we require in a chamber for the successful manufacture of sulphuric acid are sulphurous acid, hyponitric acid, air or oxygen, and steam.

It will be seen that a very small quantity of nitrate of soda is required to convert the sulphurous acid into sulphuric acid; in fact, if no loss were sustained, the chamber being once filled with the nitrous compounds, no more would be required. This, however, is not the fact in practice, for when the chambers are working properly, and every precaution used to recover the excess of nitrous compounds required in the making of acid, a loss of from 3 per cent to 6 per cent of nitre is sustained. There are three sources of loss—First, the acid on the chamber-floor absorbing nitrous compounds; second, from that which escapes absorption in the absorbing-towers; and, third, from the nitric acid remaining in the sulphuric acid after it has been passed through the denitrating columns.

(To be continued).

ON THE

SULPHUR DEPOSITS OF KRISUVIK, ICELAND.

By CHARLES W. VINCENT, F.C.S.

(Concluded from p. 114).

It is somewhat to be regretted that no one amongst the numerous eminent men, men accustomed to experimental investigations and acute observers, who have since traversed this region, should have investigated the question of the origin of these hot springs and sulphur deposits from the point of view which was thus displayed by these careful and painstaking philosophers.

The phlogistic theory being generally accepted in their day, and the chemistry of the earths and metals being in a very undeveloped state, we cannot now accept to its full extent the explanation they put forth of these phenomena; but the facts they disclose appear to me to be of the highest value, and to afford a clue which, if carefully followed, may lead to discoveries of much importance in the domain of volcanic energy.

The conclusion they drew from their investigation is, that the hidden fires of Iceland dwell in the crust of the earth, and not in its interior; that the boiling springs and the mud cauldrons certainly do not derive their heat from the depths of our globe, but that the fire which nourishes them is to be found frequently at only a few feet below the surface in fermenting matters, which are deposited in certain strata.

By their theory the gases from the more central parts of the earth penetrate these beds by subterranean channels, and so set up the chemical action, producing fermentation and heat, these channels also forming the means of intercommunication between the separate sites of activity, and equalising and transferring pressure.

To return to their facts. They further observed that the heat is invariably found to be greatest in the blue and bluish-grey earth; that these earths almost always contain sulphuric acid; that they contain also sulphur, iron, alum, and gypsum; and lastly, that finely-divided particles of brass-coloured pyrites are visible throughout the whole of the beds when heat exists.

Sulphuric acid is found in the hot beds above and below that which is the hottest, but this latter manifests no acidity that is sensible to the taste.

Sulphuretted hydrogen is continually evolved from the clays containing the brass-coloured pyrites. Silver coins dropped into a hole made in these strata become rapidly reddened, and brass becomes quite black if held over it for a short time.

Lastly, not only does the heat increase and diminish in various successive layers of the earth in the neighbourhood of the active springs, but the locality of the heat, as might be expected from their previous observations, travels very considerably in different years.

The solfatara of Krisuvik, with the mountains about it, is shown in the accompanying sketch by M. Eugène Roberts. It appears from afar to occupy the place of an ancient crater, but, as we have already seen, it is not near the crater about the centre of the drawing, but at a considerable distance from the old volcanic centre, that the thermal springs and sulphurous exhalations have their present origin.

Wherever they may have been previously, the springs are now situated between two mountains; the one, Badstofer, on the right, originally composed of lava, the other, Vesturhals, on the left, of basaltic formation. Both by the action of the thermal springs are undergoing a process of disintegration and reconstruction.

The kind of hills which form the solfataras, properly so called, increase in extent day by day, by the addition to the disintegrated rock of sulphur, and of sulphurous and sulphuric acids.

The yellow sulphur earth contains about four per cent of free sulphuric acid; sometimes a little free hydrochloric acid, and a variety of sulphates, as might be supposed. Treated with distilled water the filtered solution reddens litmus strongly; on addition of acetate of lead a flocculent precipitate is produced, which, when heated with carbon, disengages sulphurous acid.

The sulphur is found in many different conditions, but for the most part in the same finely-divided, whitish-yellow form in which it is precipitated from sulphuretted hydrogen solutions. Where it assumes other states, crystallised in tears on the surface of the rocks, or coagulated in veins, it is on account of its having undergone subsequent heating. Of its primary origin by the decomposition of sulphuretted hydrogen, there is in my opinion no doubt.

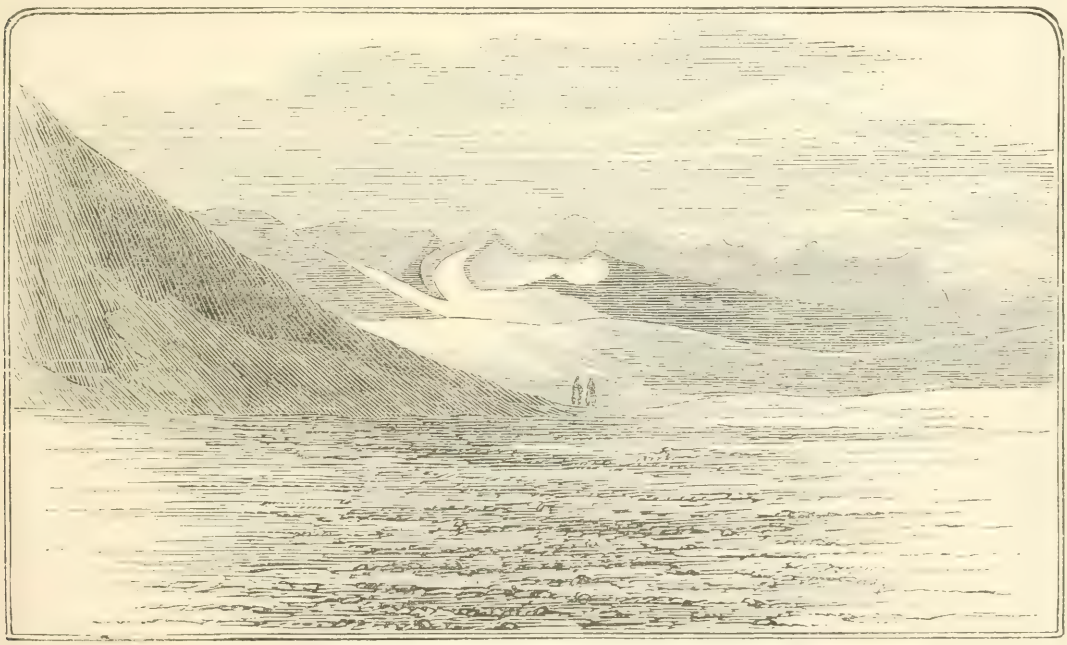
Prof. Bunsen visited Krisuvik in 1845: his opinion is that sulphurous acid is evolved from the earth's interior, which, oxidised either at the surface by the atmosphere, or at subterranean depths by atmospheric oxygen dissolved in cold water, is converted into sulphuric acid. The sulphuric acid thus generated is diffused among the constituents of the decomposed beds. This process represents the first stage of the fumerole action, which is manifested in the namar or solfatara of Krisuvik.

Sulphur is now generally regarded as emanating from the stage of intermittent lethargy of a volcano, and the sulphides of iron, copper, arsenic, zinc, selenium, &c., fall in the same category as sulphur; they are secondary, not primary, formations. In the stage further off we have the host of sulphates produced by the oxidation of the sulphur into sulphuric acid, and its subsequent reaction on the metals and earths with which it becomes associated.

The description of the Sicilian sulphur beds coincides so very exactly with that of the Icelandic mines, that one might pass very well for the other. D'Aubigny pictures nearly the whole of the central portion of Sicily as being occupied by a vast bed of blue clay or marl, in which are numerous and thick beds of gypsum and sulphur, and a mud cauldrons, and geysers are found in all parts of the region, and the description given by Mr. V. Hayden, of the Yellowstone lake and its vicinity, in every respect coincides with those of the geysers, mud cauldrons, and hot springs of Iceland.

In all cases there was found to be free access of water; free sulphur was widely dispersed, and the steam-jets were invariably accompanied by large quantities of sulphuretted hydrogen. The subterranean action in this country does not appear to have continued long enough to produce beds of sulphur and sulphur earths; but has, nevertheless, been of sufficiently long standing to build up geyser tubes of so great a length that the internal pressure has formed other vents, rather than lift the immense column of water above it.

The water of the springs contains sulphuretted hydrogen, lime, soda, alumina, and a slight amount of magnesia; some of these are only occasionally at the boiling-point, and these, when the temperature is reduced below 150° F., deposit great quantities of the sesquioxide of iron, which lines the insides of the funnels, and covers the surface of the ground wherever the water flows. If the reaction consists in the decomposition of iron pyrites, and the sul-



combination of this mineral with iron and copper. The natural process by which they have been formed must, I think, be the same in each case. At Krisuvik copper has been found only in small quantities, but that is probably because it has not been sought for below the surface. Carbonate of copper, associated with sulphate of lime, is of frequent occurrence, and native copper has to a limited extent been discovered.

A district in America, very similar in most of its characteristics, has recently been explored, The great hot-spring region of the sources of the Yellowstone and Missouri rivers, in the United States, has, on account of the wonderful natural phenomena there manifested, been set apart by the United States Congress as a great national park for all time.

The whole of this district is covered with rocks of volcanic origin of comparatively modern date. At present there are no signs of direct volcanic action going on, but the secondary kind of action, resulting probably as at Krisuvik, from the disintegration and decomposition of beds of volcanic origin, is in full progress. Boiling springs, phur is carried sufficiently far off to prevent its re-combination with the iron to form iron sulphate, the formation of the iron sesquioxide is fully accounted for.

As a rule, the groups of hot springs are, as in Iceland, in the lower valleys, and either along the margins of streams, or nearly on a level with them. The grand area where they occur is within the drainage of the Yellowstone, where a space of 40 miles in length with an average width of 15 miles, is either at the present time, or has been in the past, occupied by hot springs.

That the quantity of sulphuric acid here produced is very large is proved by the immense quantity of alum which is found, for the streams, the mud, the earth are thoroughly impregnated with it. The funnel-shaped craters from which the boiling mud is ejected, are so similar to those at Krisuvik that the figure on page 113 will answer for both places. The circular rim varies from a few inches to several feet in diameter. Sometimes these are clustered close together, yet each one being separate and distinct from the others.

The foregoing are the most prominent facts connected

with the development of sulphur from the earth in the elementary state. The full explanation of all the phenomena accompanying it appears to me to be the key by which the great secret of volcanic energy may be ultimately unlocked. At present it appears to be doubtful whether the sulphur results from the decomposition of metallic sulphides, by heat and water combined, or by sulphuric acid formed by the oxidation of sulphurous acid. In the one case, the whole action is so far within our reach that it should not be an insurmountable difficulty to establish the point as to whether the whole action does not depend on the percolation of water into beds of pyrites surrounded by other beds which are non-conductors of heat.

The other view, viz., that the sulphur proceeds as sulphurous acid from a lower depth, is, on account of the more complicated action required, far from being as satisfactory to my mind as the more simple supposition above.

Until boring experiments have been made, conducted with great care, and to considerable depths, no positive conclusion can be arrived at. It is also an element in the question of much importance to discover whether the beds penetrated by the water are already heated, whether the water is heated before it reaches the sulphur-bearing strata (the clays containing pyrites), or whether both are not alike cold till they have been for some time in contact.

Less than a quarter of a mile from the hot springs is a lake, Geslravatn, formed by the filling up of an extinct crater. This the inhabitants describe as being fathomless (Mr. Seymour, last year, found no bottom at five and twenty fathoms). The depth is, at any rate, very considerable. Although so close to a spot where the ground is, even at the surface, scorching to the feet, the water in this lake is ice-cold. Sir George Mackenzie also remarked a somewhat similar fact. On the side of the sulphur mountain, amidst the seething, steaming hills of almost burning earth, a spring of clear cold water was met with. To my mind these facts are most in accordance with the view that the action is local and self-dependent.

The Krisuvik sulphur mines have been worked at various times, but want of proper roads, and ignorance of the proper method of extracting and refining the sulphur, have prevented their proper development. The Sicilian mines can be worked at a considerable profit, where, more than 390 feet below the surface, beds are met with containing only 15 per cent of sulphur. At Krisuvik, absolutely on the surface, clays are met with which contain from 15 to 90 per cent of sulphur. Under proper and careful supervision their future should be prosperous.

Two German gentlemen, under the auspices of the Danish Government, worked these mines in the early part of the last century, and so much was exported to Copenhagen during the time the excavations were carried on, that a sufficiently large stock was laid up to serve the consumption of Denmark and Norway from 1729 to 1753.

Horrebow describes the sulphur mines as being actively worked from 1722 to 1728, to the great advantage of the inhabitants, who reaped much profit from its extraction.

By his account of their mode of prosecuting this enterprise, the sulphur does not appear to have been refined in the island, but exported in its crude state. The less active mines were chosen for cutting into. He says:—There is always a layer of barren earth upon the sulphur, which is of several colours, white, yellow, green, red, and blue. When this is removed the sulphur earth is discovered, and may be taken up with shovels. By digging 3 feet down the sulphur is found in proper order. They seldom dig deeper, because the place is generally too hot, and requires too much labour, also because sulphur may be had at an easier rate, and in greater plenty, in the proper places. Fourscore horses may be loaded in an hour's time, each horse carrying 250 lbs. weight. The best veins of sulphur are known by a kind of bank or rising in the ground, which is cracked in the middle. From hence a thick vapour issues, and a greater heat is felt than in any other part. These are the places they choose for digging, and after removing a layer or two of earth, they come to the sulphur, which they find best just under the rising of the ground, when it (the sulphur) looks just like sugar candy. The farther from the middle of the bank the more it crumbles, at last appearing as mere dust. But the middle of the bank is an entire hard lump, and is with difficulty broken through. The brimstone, when first taken out, is so hot that it can hardly be handled, but grows cooler by degrees.

In two or three years these veins are again filled with sulphur. The death of the person at Copenhagen who had the sole and exclusive privilege of exporting sulphur from Iceland put an end to what had promised to be a very thriving industry. The inhabitants continued to collect the sulphur-earth for some time after its exportation had ceased; and many of them lost considerably by it, large quantities having been gathered which they were never able to dispose of.

According to Dr. Perkins, the sulphur mines were again worked by the Danish Government for fifteen years, but the method of purifying adopted was very imperfect. The sulphur-earth was heated in iron boilers, and, when the sulphur was melted, fish oil was added, and the whole mass stirred up. On allowing the mixture to stand for a time, the earthy matter formed a soap on the top of the molten mass; this being removed, tolerably pure sulphur remained behind.

In 1832, these mines were visited by K. von Nidda, the celebrated geologist, by whose advice a Danish merchant, named Kruntynon, purchased them. He only worked them for a short period. The sulphur-earth was collected without much regard being paid to the relative richness of the beds. It was taken on the backs of horses to Havnafiord, and thence shipped to Copenhagen. The cost of transport brought the sulphur to too high a price to render the undertaking successful.

In 1857, political matters caused the attention of Her Majesty's Government to be directed to finding a new source of sulphur supply. Commander J. E. Commerell, of Her Majesty's ship *Snake*, was sent to Iceland by the Lords Commissioners of the Admiralty, to visit and report upon the capabilities of the mines of Krisuvik and Husavik. He found that the nearest safe port to the Krisuvik beds was Havnafiord; this port is 14 miles from the sulphur-beds by the present roads, and 9 miles from Reikjavik. The harbour is well sheltered, with good anchorage of 7 or 8 fathoms three cables length from the beach; it at present enjoys as much traffic as Reikjavik. The road from Krisuvik might be much shortened, and a tramway might also be laid down. During the past year a survey has been made, and plans drawn, for a railway or tramway to Havnafiord.

The actual extent of the sulphur-beds it is quite impossible to calculate; forty-seven have been already discovered. The deposit of sulphur Commander Commerell personally saw he describes as amounting to many thousands of tons, and, all the mines being in what is called a "living" state, the sulphur taken away is reproduced in two or three years. He considers that sulphur in a pure state could be shipped at Havnafiord for £1 per ton.

The sulphur at Myvatn, though great in quantity, is, he considers, at too great a distance from a port of embarkation to permit its extraction being carried on with any chance of competing with that from the Krisuvik mines.

No further steps were taken in the matter by the British Government, the political complications which led to the expedition having been removed; but the attention of English merchants having been drawn to these rich deposits by the highly favourable character of Commander Commerell's remarks, renewed attempts are being made to render commercially available the immense sulphur-producing power which the

Krisuvik solfataras undoubtedly possess. To some of these gentlemen I am greatly indebted for much valuable information, put at my disposal for the purposes of this paper, and, amongst them, I have specially to tender my thanks to Mr. Ramsdale and Messrs. Thorne, of Gracechurch Street, and particularly for the use of numerous and carefully-selected samples of the sulphur-earths which were freely placed at my disposal. These samples I hope to make the subject of a future paper.

Since writing the foregoing paper, I mentioned, in the course of conversation with Sir Henry Holland, the conclusions which are derived from the examination of all the trustworthy facts relating to the sulphur deposits. This led him to examine entries in his unpublished diary, made at Krisuvik in 1810. The theory which he then conceived so thoroughly agrees with all that has been learnt respecting the phenomena in question, that I, with his kind permission, print an extract from his note-book:—

"The theory of these sulphurous springs (if springs they may be termed) at Krisuvik is an interesting object of inquiry. They are situated in a country decidedly of volcanic origin. The high ground on which they appear is composed principally of the conglomate or volcanic tufa, which has before been noticed. The source of the heat which can generate permanently so enormous a quantity of steam must, doubtless, reside below this rock; whether it be the same which produces the volcanic phenomena may be doubted, at least if the Wernerian theory of volcanoes be admitted. It certainly seems most probable that the appearances depend upon the action of water on vast beds of pyrites. The heat produced by this action is sufficient to raise an additional quantity of water in the form of steam, which makes its way to the surface, and is there emitted through the different clefts in the rocks. The sulphates of lime and alumina, appearing upon the surface, are doubtless produced, in process of time, by these operations. In corroboration of this view it may be observed that the quantity of steam issuing from the springs at Krisuvik is always greater after a long continuance of wet weather, and that whenever earthquakes occur on this spot it is during the prevalence of weather of this kind."

The learned, and now aged, author expressed the highest gratification that the views which he formed at twenty-two years of age should possess so much value so many years after.

During the reading of the paper Mr. Vincent illustrated his subject by several experiments, showing how the deposition of sulphur might have been effected. He also showed a spectrum obtained by burning some of the sulphur-earth, and it appeared that the thallium line became visible in the spectrum. Specimens of the various sulphur-yielding earths from Iceland were exhibited, and Dr. Clement Le Neve Foster showed samples from the Italian sulphur districts.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 6th, 1873.

Dr. GLADSTONE, F.R.S., Vice-President, in the Chair.

AFTER the minutes of the previous meeting had been read and confirmed, and the donations to the Society announced, the names of Messrs. E. H. Fison, Charles Thomas Kingzett, Alonzo J. Rider, William Andrew Prout, B.A., Roland Finch, William Morgan, Ph.D., and Henry Richardson, were read for the first time. For the third time—Messrs. George Ainsworth, Alexander Bottle, Richard Joseph Deeley, and James Walter Montgomery, who were then ballotted for and duly elected.

The first paper, "*On the Action of Hydrochloric Acid on Codeine*," was then read by the author, Dr. C. R. A. WRIGHT, who, after referring to a former paper, containing an account of the action of hydrochloric acid on morphine, stated that codeine, treated with hydrochloric acid at 100° for 2½ hours, gave a mixture of two bases, $C+3HCl$ and $\overline{C}+4HCl-2H_2O$, where $\overline{C}$ stands for $C_{36}H_{42}N_2O_6$. When the action was continued for a longer time, methyl chloride was evolved, and a mixture of two isomeric bases obtained, intermediate in composition between morphine and "apomorphine"—namely, $\overline{M}_2-2H_2O$ and $\overline{M}_4-4H_2O$ respectively, where M equals $C_{34}H_{36}N_2O_5$. With hydrobromic acid the first action was similar to that of hydrochloric acid, but its continued action gave rise to products which are not identical with those formed by means of hydrochloric acid, whether at 100° or at a higher temperature. An extensive table of the derivatives of codeine obtained up to this time accompanied the memoir.

After the Chairman had expressed the thanks of the Society to Dr. Wright for his valuable and laborious researches on this subject, a paper "*On New Processes for Mercury Estimation, and some Observations on Mercury Salts*," by J. B. HANNAY, was read by the Secretary. The author, finding the ordinary processes for the determination of mercury either very tedious or deficient in accuracy, has devised two new ones which are free from these objections. The first, which is a volumetric method, depends upon the fact that potassium cyanide dissolves the precipitate produced by ammonia in a solution of mercury chloride. A few drops of ammonia are first added to the solution containing the mercury in the state of chloride, and then a standard solution of potassium cyanide until the turbidity produced by the ammonia disappears. If arsenic, copper, &c., be present, the solution should be precipitated by sulphuretted hydrogen, the arsenic, &c., separated by sulphide of ammonium, and the mercury sulphide dissolved in aqua regia. The other method consists in decomposing the mercury, in solution as sulphate, by the electric current in a platinum basin, the mercury being deposited on the basin in the metallic state and weighed as such. The author has also made several experiments on mercury salts, and finds that hydrochloric acid completely decomposes mercury sulphate, and that mercury chloride can even be boiled with concentrated sulphuric acid without suffering decomposition.

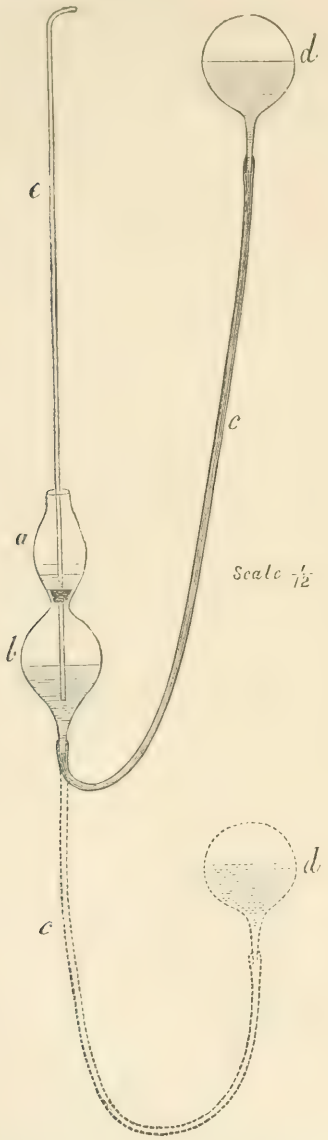
Mr. F. FIELD remarked that, in separating the arsenic and antimony, potassium sulphide must not be used, as mercury sulphide was comparatively soluble in it.

The next paper, "*On a Method of Estimating Nitric Acid*," by T. E. THORPE, F.R.S.E., was also read by the Secretary. The author finds that the copper-zinc "couple" of Messrs. Gladstone and Tribe completely decomposes nitrates with formation of ammonia, which can then be estimated as platinochloride, or, if the amount be but small, by Nessler's test; particular care, however, is required with ammonium nitrate, the strength of the solutions employed considerably affecting the result. The author believes that this process, applied to the determination of nitrates in potable waters, possesses considerable advantages over the ordinary method—namely, by avoiding the introduction of nitrates in the potash or soda employed, and the frothing of the strongly alkaline solution when distilled. The author also employs the "couple" for the reduction of chlorates and iodates: it seems to have no action on urea.

Dr. GLADSTONE said he had listened to the paper with great interest, and would welcome every labourer in the extensive field opened up by the use of the copper-zinc couple, since it was of great importance that we should know what substances were decomposed by it and what were not.

Mr. W. THORP said he was much pleased with the paper, and had no doubt the method would be valuable in determining nitrates when they were present in tolerably

large quantity, but he did not see the advantage it presented for water analysis over that devised by the late Mr. Chapman. He had made several hundred determinations by the last-mentioned process, but had never met with the difficulties mentioned by Dr. Thorpe. The presence of any trace of nitric acid in the potassic hydrate was readily removed by boiling the solution with a little aluminium. From the account given of it in the paper, he should imagine the new method to be more troublesome and tedious than the old one.



Dr. Debus quite agreed with the speaker that the new method did not seem to possess any practical advantages over the old one. It was, however, interesting from a theoretical point of view that zinc and copper in contact should reduce nitric acid to ammonia.

A "*Note on a Reaction of the Acetates upon Lead Salts, with Remarks on the Solubility of Lead Chloride*," was then read by the author, Mr. F. Field, F.R.S. When sodium chloride is added to either lead acetate or nitrate, a white precipitate is formed, which is generally regarded as lead chloride; it is, however, entirely dissolved by acetic acid for the moment, crystals of lead chloride separating from the clear solution only after the lapse of a short time. By far the most sensitive test for the presence of acetates or formates is a copper salt in the presence of sodium chloride, for when such a solution is heated, a copious precipitate of oxychloride of copper is immediately produced. The author has also made some determinations of the solubility of lead chloride in a solution of sodium chloride, and notices the ease with which lead sulphate is decomposed by hydrochloric acid or sodium chloride, so that sulphuric acid produces no precipitate in a solution of lead chloride in sodium chloride.

In reply to a question by Dr. Voelcker, the author said he had not made any attempt to ascertain whether this method could be employed for the quantitative determination of acetic acid.

Dr. Russell then took the chair, which was vacated by Dr. Gladstone to read a communication entitled "*Observations on the Nature of the Black Deposit in the Copper Zinc Couple*, by J. H. Gladstone, F.R.S., and A. Tribe, F.C.S. As it had been suggested that the black deposit referred to, contained more or less metallic zinc, the authors had instituted experiments to ascertain the truth of the matter. When the solution of copper sulphate is poured on the zinc, a deposit of pure copper is produced as long as the solution contains any of that metal. As soon, however, as the copper is exhausted, other reactions supervene: zinc oxide is formed by the action of the oxygen dissolved in the water, and metallic zinc is also deposited. Such a black deposit examined under the microscope is seen to consist of branches of crystallised copper studded with crystals of metallic zinc, the latter of which at once disappear if washed with a solution of copper sulphate. It would therefore appear that the black deposit on the copper-zinc couple as usually prepared can contain little or no metallic zinc. The authors also made some remarks on the platinum-zinc and gold-zinc couples, which, as might have been expected, are more active than the copper-zinc couple, and concluded by a discussion of the theory of the electro-chemical actions involved.

Dr. Russell, after returning the thanks of the Society to the authors for an account of their exceedingly interesting experiments, said that the statement, that as long as there was excess of copper sulphate in solution no zinc was deposited along with the copper on the zinc plate, was at variance with certain experiments he had made some time ago. When a zinc plate is immersed in a dilute solution of copper sulphate, it immediately becomes covered with a black deposit; but if the plate be moved about in the liquid so as to remove it from the solution of zinc sulphate formed in contact with it, the deposit immediately acquires a red colour. The black deposit, moreover, evolves hydrogen when treated with acid, whilst the red does not.

Dr. Muller remarked that iron plunged into a solution of sulphate of copper gives at once a red deposit; moreover, any metal appearing black from being in a minutely divided state acquires its proper colour on being rubbed with an agate burnisher, but this black deposit does not.

Dr. Wright observed that, *a priori*, it was quite possible that zinc and copper should be deposited together, since brass could be electro deposited.

Dr. Schenck drew attention to the fact that when a couple of copper and cadmium is immersed in a solution of cadmium sulphate, metallic cadmium is deposited on the copper.

A note on "*An Air-Bath of Constant Temperature Between* 100° *and* 200° *C.*," by Dr. H. Sprengel, was then read. This ingenious contrivance consists of a bath, similar to the ordinary hot-water oven, made of sheet-lead autogenously soldered, and filled with dilute sulphuric acid boiling at the desired temperature. In order that the temperature may remain constant, the water which distils from the

dilute sulphuric acid is condensed and allowed to flow back again into the bath by means of a worm of lead cooled by the atmosphere, or a long vertical metal or glass tube.

Dr. RUSSELL in thanking the author, said the Society was much indebted to him for his simple and ingenious form of air-bath, and finally adjourned the meeting until Thursday, March 20, when a lecture "On Iron and Steel" will be delivered by C. W. Siemens, Esq., F.R.S., &c.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 18th, 1873.

E. W. BINNEY, F.R.S., F.G.S., Vice-President, in the Chair.

DR. JOULE, F.R.S., gave some further account of the improvements he had made in his air-exhausting apparatus. As stated in the last *Proceedings*, he had substituted a caoutchouc tube, attached to the neck of a glass vessel, for the original perpendicular pipe with its stopcock. This is seen in the sketch (see preceding page), *c* and *d*. The two positions—viz., when *b* is being filled, and when it is being emptied—are shown by the full and the dotted drawing. It is convenient to introduce no air into *d* except that required to act as a cushion to avoid a shock when filled in the lower position. Sulphuric acid may be introduced into the receiver to be exhausted, but it is perhaps more convenient to place it over the mercury in *a*, whence it may occasionally be drawn into *b*, to effect the drying of the internal parts of the apparatus. Dr. Joule has met with some difficulty in using mercury gauges to ascertain the residual pressure, inasmuch as he finds that mercury thoroughly boiled in clean glass tubes does not show a convex surface, but adheres strongly to the glass. However, he has confidence in giving the following results, in working with his apparatus with acid of various strength, obtained by successive dilutions of sulphuric acid of sp. gr. 1·845 by volume:—

Sulphuric Acid.		Water.		Pressure in Inches of Mercury.
3	+	0	..	Inappreciable
3	+	1	..	Inappreciable
3	+	2	..	0·01 at 70°
1	+	1	..	0·03 at 63°
1	+	2	..	0·15 at 63°
1	+	4	..	0·30 at 55°
0	+	1	..	0·37 at 47°

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Le Moniteur Scientifique Quesneville, March, 1873.

Contains the following original memoirs relating to chemistry and collateral subjects:—

Mode of the Formation of the Tissues in the Animal and Vegetable Organisms.—Ch. Blondeau.—A physiologico-chemical essay.

Present Condition of Agricultural Science in France and Other Countries.—L. Mussa.—The continuation of this monograph. This portion is divided into the following sections:—Aërial nutrition; carbonic acid; nitrogen; respiration of plants; elaboration of the juice in the leaves: perspiration of plants; flowers (blossom, bloom), their functions; the fruit; seed, grain and its ripening; the seeds of plants; germination of the seed. To be continued.

On Aniline Blacks.—C. F. Brandt.—This paper treats at length on the modes of preparation, formation, and nature of the aniline blacks, which consist, according to the author, of two distinct blacks mixed together in variable proportions. One of these, formed by the chlorated substitutes of aniline, is very fast, resisting almost all chemical reagents; but alone it is less beautiful than the other black, the product of the oxidation of the aniline salt. This substance really exhibits a deep violet-blue hue, which appears black in the concentrated state, but it is far less fast than the former; and although it resists soap, it becomes of a greenish colour by even very weak acid. In order to obtain a beautiful as well as a fast black, it is necessary for the two blacks to be present in proper proportion, and this depends upon the proportion of chlorate contained in the mixture.

New Researches on Propionic, Butyric, and Valerianic Acid.—T. Pierre and E. Puchot.—This exhaustive monograph is divided into the following sections:—Propionic acid, its mode of preparation; salts, viz., baryta, silver; butyric acid, its mode of preparation from butylic alcohol by oxidation, and properties of the acid; salts, viz., baryta, silver, ethylic, methylic; valerianic acid, mode of preparation from valerianate of potassa.

Bibliography.—Under this heading attention is called to the following new publications:—"Traité de la Détermination des Terres Arables dans le Laboratoire," par M. P. de Gasparin; Paris: G. Masson. This book has been specially written for agriculturists, and contains instructions for the easy estimation of phosphoric acid, potassa, lime, magnesia, soda, silica, iron, alumina, &c. in arable soils. All the described processes of analysis have been tested and practically studied by the author, who is an eminent practical agriculturist, and also a distinguished chemist. "L'Année Scientifique et Industrielle, ou Exposé Annuel des Travaux Scientifiques, des Inventions et des Principales Applications de la Science à l'Industrie et aux Arts qui ont Attiré l'Attention Publique en France et à l'Etranger, Accompagné d'une Nécrologie Scientifique," par M. Louis Figuier; Paris: Hachette et Cie. The sixteenth yearly volume of this work contains a *resumé* of the labours of scientific institutions and societies. The other portions of this valuable *recueil* have also been greatly extended.

Les Mondes, March 6, 1873.

Election of Berthelot.—This celebrated *savant* has been elected one of the Fellows of the Académie des Sciences by a large majority.

Synthesis of Acetic Acid.—A. and J. Thenard.—By passing the electric current of a Ruhmkorff coil through a mixture of carbonic acid and protocarburetted hydrogen, the authors have, in the presence of M. J. Dumas, obtained acetic acid; thus combining two inorganic compounds in an organic substance.

Artificial Production of Cold by the Expansion of Air.—J. Armengaud.—The author has constructed an apparatus in which the air may be made to expand so rapidly, that while on entering its temperature is 15° it leaves the apparatus at −20°.

Volatilisation of Iron.—Dr. Elsner.—The author, director of a royal porcelain manufactory at Berlin, has placed in an unglazed porcelain crucible, closed with a lid, a piece of malleable iron, and exposed it for several hours to a temperature of at least 3000° (the heat of the porcelain kiln). On withdrawing the crucible from the kiln the lid was found lined with small crystals (needle-shaped) of iron which had been volatilised.

Bibliography.—"L'Architecture du Monde des Atomes," par M. A. Gaudin; Paris: Gauthier-Villars. This work is highly spoken of by the celebrated *savant*, Dumas, and contains the results of the author's labours during the last forty years. "Les Machines; leur Historie, leur Description, et leur Usages," par E. With; Paris: Baudry. A complete mechanical technology, illustrated by woodcuts, and full of useful as well as practical information.

Petites Annales de Chimie.—E. J. Maumené.—The twelfth portion of this monograph, elucidated by a large number of algebraico-chemical formulæ.

Flame of Compressed Gases.—F. Benevides.

Annalen der Chemie und Pharmacie, vol. clxvi., No. 2, March 1, 1873.

On Some New Derivatives of Sulpho-Carbaminic Acid.—H. Hlasiwetz and J. Kachler.—In the introduction to this essay the authors refer to the researches of Städeler and E. Mulder on this subject. Then we have the detailed account of the mode of preparation and properties of a peculiar combination of ammonia and sulphide of carbon, which is formed only when the two bodies are reacting upon each other in the presence of camphor. The new substance so obtained is a solid crystalline material, formula, $C_2H_{10}N_4S_2$. It is unstable, and readily decomposed by nitric acid and caustic alkalies; it yields with sulphate of copper a yellow-coloured compound—

$$C_2H_2Cu''N_2S_2.$$

When the body first mentioned is treated with perchloride of iron, there is formed a new compound, $C_2H_8N_2S_4$, a crystalline substance, quite insoluble in water and ether, but soluble in boiling alcohol. The body $C_2H_{10}N_4S_2$ forms with aniline a crystalline compound, soluble in boiling alcohol, formula, $C_{14}H_{18}N_4S_2$. The authors propose to call these compounds "thiuram" (from *θειον*) because the group NH_2-CS- prevails in these bodies. A series of formulæ, with the addition of the old and new names, is given.

Some of the Nitrogen Compounds of Anthrachinon.—R. Bœttger and Th. Petersen.—The second instalment of a monograph on this subject. This portion is divided into the following sections:—α-mononitro-anthrachinon, $C_{14}H_7(NO_2)O_2$; α-monoamido-anthrachinon, $C_{14}H_7(NH_2)O_2$; α-diazo-anthrachinon-nitrate,—

$$C_{14}H_7N_2O_2.NO_3;$$

behaviour of mononitro-anthrachinon with concentated sulphuric acid.

The Vanadates of Thallium.—Th. Carnelly.—This essay, elucidated by a large number of formulæ, treats exhaustively on the combinations of vanadic acid with thallium.

On Ethylamyl.—H. Grimshaw.—An abstract of the author's published memoir on this subject, an observation also applying to the memoir previously mentioned.

Heptanes of the Petroleum.—C. Schorlemmer.—This monograph, elucidated by a large number of formulæ, treats more particularly on an acid, $C_7H_{11}O_2$, very similar to isoenanthylic acid, boiling-point 209° to 213°, and on the ketone and ether derivatives.

Crystallographical Communications.—C. Klein.—Illustrated with engravings.

Observations on My Water Air-Pump (Pompe Syrène).—N. Jagn.—The contents of this paper bear upon the rectification of some misunderstanding in reference to the construction, mode of action, and principles involved in this instrument.

On Excretin.—Dr. F. Hinterberger.—This paper treats on a peculiar substance which occurs in small quantity in human excrements, and was first noticed by Marcet. The author gives a detailed account of the mode of preparation of this substance, which has the formula, $C_{20}H_{36}O$, and combines with bromine, forming the compound—

$$C_{20}H_{34}Br_2O.$$

MEETINGS FOR THE WEEK.

MONDAY, March 17th.—Medical, 8.
TUESDAY, 18th.—Civil Engineers, 8.
—— Zoological, 8½.
—— Anthropological, 8.
—— Royal Institution, 3. Prof. Rutherford, "On Forces and Motions of the Body."
WEDNESDAY, 19th.—Society of Arts, 8.
—— Meteorological, 7.
THURSDAY, 20th.—Royal, 8½.
—— Royal Society Club, 6.
—— Royal Institution, 3. A. Vernon Harcourt, M.A., F.R.S., "On the Chemistry of Coal and its Products."
—— Zoological, 4.
—— Chemical, 8. C. W. Siemens, F.R.S., "On Iron and Steel."
FRIDAY, 21st.—Royal Institution, 9. Capt. E. D. Lyon, "On the Mythology of India."
SATURDAY, 22nd.—Royal Institution, 3. Prof. Max Muller, LL.D., "On Darwin's Philosophy of Language."

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THE CHEMICAL NEWS.

VOL. XXVII. No. 695.

PRELIMINARY NOTICE ON

SOME NEW CHLORINATED COMPOUNDS OBTAINED FROM ORCIN.

By JOHN STENHOUSE, LL.D., F.R.S., &c.

Pentachlororcin Hypochlorite.—In a paper published at the close of the year 1871 (*Proc. Roy. Soc.*, vol. xx., p. 77) I described a substance having the formula $C_7H_4Cl_6O_3$, to which I gave the name of pentachlororcin hypochlorite. It would appear that the constitutional formula, $C_7H_3Cl_5O_2,HClO$, then ascribed to it, is really the correct one; for I find that pentachlororcin, $C_7H_3Cl_5O_2$, can be directly converted into the hypochlorite by treatment with calcium hypochlorite, when a compound, probably $(C_7H_3Cl_5O_2)_2CaCl_2O_2$, is first formed, which, by the action of acids, yields the pentachlororcin hypochlorite. I hope ere long to be able to describe pentabromorcin hypobromite, prepared by a similar process from pentabromorcin.

Action of Ammonia on Pentachlororcin Hypochlorite.—When finely-powdered pentachlororcin hypochlorite is treated with dilute ammonia, considerable heat is produced, and, if the ammonia be sufficiently concentrated, the mixture solidifies to a mass of minute needles; at the same time a gas is given off, and a powerful odour of chloroform becomes apparent. The product may be purified by crystallisation from hot alcohol, when it forms long silky needles, which fuse at 187°. They are almost insoluble in water, but readily soluble in hot alcohol and in benzol; moderately so in carbonic disulphide, ether, and hot petroleum, crystallising out almost entirely from their solution in the latter on cooling. When subjected to analysis, this substance gave results agreeing tolerably well with the empirical formula $C_6H_5Cl_3NO$. If this be correct, the new compound may be regarded as an amido-trichlor-phenol, and the reaction could then be represented by the equation—

$$C_7H_4Cl_6O_3 + 2NH_3 = C_6H_5Cl_3NO + CHCl_3 + 2H_2O + N.$$

The compound is only decomposed with difficulty by the action of acids or alkalies, being readily soluble in concentrated sulphuric acid, and precipitated again, apparently unaltered, on the addition of water.

Action of Aniline on Pentachlororcin Hypochlorite.—When aniline in excess is added to a solution of pentachlororcin hypochlorite in benzol, and the mixture allowed to stand, it deposits a new compound in tufts of colourless needles. These, unlike, the product obtained by the action of ammonia, are readily decomposed by dilute acids, leaving a colourless, crystallisable compound, readily soluble in carbonic disulphide.

Action of Calcium Hypochlorite on Orcin in Presence of Excess of Acetic Acid.—If, in the preparation of pentachlororcin hypochlorite by the action of hydrochloric acid and calcium hypochlorite on orcin in the manner previously described (*Proc. R. S.*, vol. xx., p. 77), acetic acid be substituted for hydrochloric acid, no precipitate is produced even after standing some hours. At the end of five or six days, however, the sides and bottom of the vessel will be found to be covered with colourless crystals, differing totally in appearance from the pentachlororcin hypochlorite. After being purified by crystallisation, first from carbonic disulphide, and subsequently from water, it forms long, white, flattened prisms which melt at 130°. They are only slightly soluble in carbonic disulphide or boiling water, and almost insoluble in cold water; in ether and alcohol they are very soluble, somewhat less so in benzol, and moderately soluble in hot petroleum. It is soluble in hot sulphuric acid, and is re-precipitated on the addition of water. It dissolves also readily in dilute caustic soda or ammonia, acids producing a precipitate in the latter solution, but not in the former. I have been unable to obtain any definite metallic derivatives from this compound. The results of the analysis agree with the formula $C_6Cl_4H_4O_3$, and I hope soon to be able to make out its constitution by an examination of the products of its decomposition.

Action of Sulphuric Acid on Pentachlororcin Hypochlorite.—When the hypochlorite is added to concentrated sulphuric acid, and the mixture gently heated, a large amount of gas, apparently phosgene, is given off, and the pentachlororcin hypochlorite dissolves. On pouring the solution into water, an oily body is precipitated, which solidifies, after a time, when exposed to the air, and immediately on the addition of an alkali. This reaction I am at present investigating.

THE ACTION OF THE SPECTRAL RAYS IN DECOMPOSITION OF CARBONIC ACID IN PLANTS.

THIS is a subject which has of late attracted considerable attention from Continental observers.

The assertion (by Prof. Draper, of America, and others), that a curve representing the decomposing force of the various rays corresponded to the curve of brightness, has been called in question. Timirjaseff, *e.g.*, affirmed that it corresponded to the curve of heat-intensity. And, more recently, Lommel sought to show that the rays which are most active in producing decomposition of carbonic acid must be those which are most powerfully absorbed by chlorophyll, and, at the same time, have a high mechanical intensity (heat-action). He thus inferred the red rays between B and C to be the most active. Müller adduced experimental results to support Lommel's theoretical conclusions, his mode of experiment being to expose leaves in a glass vessel at various parts of the spectrum, and then determine gasometrically the amount of decomposition.

In a recent communication to the Marburg Society of Natural Science, Dr. Pfeiffer opposes these views of Lommel and Müller, and gives an account of experiments made on the subject.

He points out that chlorophyll solutions may be obtained which give the absorption-bands, and yet show no decomposition of carbonic acid, but rather absorb oxygen. Hence it is an unwarranted inference that the rays most active in decomposition are those which are extinguished. He also shows, from an experiment in which 5·7 c.c. of carbonic acid were decomposed by an Oleander leaf of 20 square centimetres' surface in two hours, how small is the amount of work represented in the starch produced; so that, if even the yellow rays had produced the whole decomposition, a weakening or extinction of them would not be observable.

In order to determine empirically the decomposing force of rays of different refrangibility, Dr. Pfeiffer adopted the method of counting the bubbles of gas given off by a branch in water. The following is an outline of his procedure:—

Two lenses, of different focal distances, were so combined that solar rays passing through them from a heliostat issued nearly parallel and formed an image 40 m.m. diameter. The diameter of this image fell on a slit 3 m.m. broad; and the rays, then passing through a prism and an achromatic lens, formed a spectrum at 2 to 2½ metres' distance having a length of 230 m.m. and a height of 50 m.m. The weakening of the rays through absorption and reflection was reckoned at about 1-12th, but the absolute intensity was not measured. The yellow was sufficiently bright to cause pain in looking at it. The

spectrum was not perfectly pure, but proved sufficiently so for the purpose.

In the gasometric method, Dr. Pfeiffer remarks there are various disadvantages. A long exposure is required, and small errors are apt to creep in, both in this and in removing the leaves from the tube; and these errors assume importance from the small quantity of carbonic acid decomposed. The method of counting gas bubbles, indeed, does not give a perfectly accurate value for the quantity of CO_2 decomposed; still, in all circumstances where the bubbles increase, there is more energetic decomposition, and conversely, the amount of correspondence being sufficient. When a plant is giving off bubbles, the slightest shadow makes a difference, and in less than a minute the new stream of bubbles becomes constant for the new light intensity.

The plant employed was *Elodea Canadiensis*. Branches of this, 45 m.m. long, fixed to a glass rod, were placed, with cut surface uppermost, in a parallel-sided glass vessel filled with water. A pasteboard cover was applied to one side of the vessel, having a vertical slit 13 m.m. in breadth opposite the branch, and including it. The vessel was then submitted to the spectral rays, which came to it at right angles through the slit. Care was taken that, in moving the vessel to a new position, the rays should still meet its surface at right angles.

The counting of bubbles began at the yellow. After each removal, a short time was allowed for the stream of bubbles to become constant. From the yellow throughout there was in every case a continuous diminution in the number of bubbles, as the following shows:—

In yellow, in a quarter of a minute,	22	bubbles.
,, orange next yellow ,,	19	,,
,, middle orange ,,	15	,,
,, orange next red ,,	14	,,
,, red next orange ,,	7	,,
,, red further off ,,	4	,,
,, ,, ,, ,,	3	,,
,, ,, ,, ,,	2	,,
,, extreme red ,,	1	,,
Back to yellow ,,	22	,,
In yellow, in a quarter of a minute,	25	bubbles.
,, middle of green ,,	9	,,
,, ,, blue ,,	6	,,
,, ,, indigo ,,	4	,,
,, ,, violet ,,	2	,,
Back to yellow ,,	24	,,

(It may be observed that, where the process became very slow, counting was continued for half a minute to one minute, and then a reduction made.)

Dr. Pfeiffer next experimented by placing a chlorophyll solution in the path of the rays, and bringing the plant to the band between B and C, which, with a breadth of 10 m.m., almost entirely covered it. The number of bubbles given off here was compared with that in the bright yellow. Reckoning the latter as 100, the average for the other was 29·1.

Thus no connection is indicated between absorption of the light rays in a chlorophyll solution and the "assimilation-value" of these absorbed rays.

On the other hand, the little-absorbed yellow rays appeared most active in decomposing CO_2, and what appeared the brightest part of the yellow gave most bubbles; so that, on moving the plant even a very little on either side, and without leaving the yellow, the number of bubbles diminished. For example, the following bubble numbers were got in half a minute's exposure:—

In brightest yellow	42	bubbles.
A little towards green ..	40	,,
Back to first position ..	42	,,
In brightest yellow	43	bubbles.
A little towards orange ..	40	,,
Back to first position ..	42	,,

From a large collation of instances are obtained the following average values for the several spectral rays, reckoning the number of bubbles in the yellow at 100:—

Red..	25·4
Orange	63·0
Yellow	100·0
Green	37·2
Blue	22·1
Indigo	13·5
Violet	7·1

The curve formed in accordance with these numbers agrees very nearly with the curve obtained by Vierordt in his measurement of brightness in the solar spectrum. From the culmination-point in yellow, to the middle of orange and green, they are almost alike; thereafter they diverge slightly.

Now this curve obtained from bubble numbers does not truly represent the assimilation curve. The numbers (as Dr. Pfeiffer had pointed out in a previous paper) were too high, and the more so the less carbonic acid was decomposed in given circumstances. The relation between the values for the gas bubbles, and the quantity of CO_2 decomposed, is, on account of individual peculiarities and other causes, not constant, and must be determined empirically. If, however, the proper reduction be made, Dr. Pfeiffer thinks the curve then obtained will have a still closer resemblance to the brightness curve.

Still, the agreement of the gas bubbles curve with the brightness curve is so close as to warrant Draper's conclusion, as to the decomposition of CO_2 in plants, that the decomposing force of the various rays corresponds in general to their apparent brightness in the spectrum.

RECIPROCAL CONVERSION OF INACTIVE TARTARIC AND RACEMIC ACIDS. PREPARATION OF INACTIVE TARTARIC ACID.

By E. JUNGFLEISCH.

In a previous paper (*Comptes Rendus*, vol. lxxv., p. 439), I described the conditions under which, by the aid of heat, dextro-tartaric acid is converted into racemic acid, and I then observed that under these conditions inactive tartaric is simultaneously formed. The further pursuit of my researches has enabled me to solve some of the questions which then arose.

Complete Conversion of Dextro-tartaric Acid.—One of first points required to be studied was the question whether the complete conversion of dextro-tartaric acid (into inactive acid) is possible, notwithstanding the presence of a large quantity of racemic acid; or that, at the temperature of 175°, a stable equilibrium takes place, which limits the production of the converted body. The dextro-tartaric acid is all converted when the action of the heat is kept up for a sufficiently long period. Moreover, when pure racemic or inactive tartaric acids are heated with water up to 175° under pressure (in sealed tubes, or in a Papin digester), I did not find in the products of this reaction any traces even of dextro- or sinistro-tartaric acids; and since an equilibrium cannot be established, except in consequence of reciprocal conversions, it is evident that the disappearance or complete conversion of the dextro-tartaric acid cannot be limited under the conditions prevailing in the above-mentioned experiment.

Equilibrium between Racemic and Inactive Tartaric Acids.—As I had found that dextro-tartaric disappears completely, it became necessary to ascertain why it is not possible by one single operation to entirely convert the tartaric acid experimented with into racemic acid. It will not be a difficult matter to prove that this is occasioned by the inactive tartaric acid, which is simultaneously produced, and which interferes and limits the reaction.

Although, as already mentioned, the dextro-tartaric acid, provided the combined action of the heat and water be kept up for a sufficiently long period of time, is completely converted into inactive and racemic acids, it is impossible to make the inactive acid disappear even by a continuous heating to 175°, because when, by the aid of water and crystallisation, the greater portion of the racemic acid is eliminated and the experiment resumed with the residue (mother-liquor) which contains the inactive acid, racemic acid is again produced, while a corresponding portion of inactive acid disappears; and when this mixture is again submitted to crystallisation, and the same course of operation repeated, the same results are obtained; but, as soon as the mixture has attained a certain composition, no more racemic acid is formed when a portion only of that present is eliminated. When pure inactive acid (prepared by a process to be presently described) is similarly treated, equal results are obtained; that is to say, it is at each operation partially converted into racemic acid, but (and I must call particular attention to this fact) more and more completely so at each repetition of the operation. When racemic acid is heated under precisely the same conditions, it is partly converted into inactive acid, the production of which ceases at a certain moment, notwithstanding that the action of the heat be kept up. When the racemic acid is eliminated by crystallisation, while the very soluble inactive acid is left in the mother-liquor, and the thus purified racemic acid again submitted to the combined action of heat and water in a closed vessel some inactive acid is again formed, and thus the operation may be several times repeated. This experiment always yields the same results, whether made with the artificially-prepared racemic acid (from dextro-tartaric acid), or with the racemic acid from Thann (occurring in certain kinds of grapes grown there). When the experiments just alluded to are conducted at temperatures between 155° and 170°, instead of heating to 175°, I found that the quantity of inactive acid formed or remaining (*subsistant*) increases, while the quantity of water present also exerts a decided influence, because the larger the quantity of water present, the larger becomes the proportion of inactive acid in the non-modifiable (not further convertible) mixture; but my experience in reference to this point is not yet very complete. It appears, however, to be an established fact that inactive tartaric and racemic acids are reciprocally convertible one into the other; but this conversion is limited, and has a tendency to assume a state of equilibrium which varies according to circumstances and is most influenced by temperature.

Preparation of Inactive Tartaric Acid.—The above observations may be applied to the easy preparation of large quantities of inactive tartaric acid, a substance first discovered by Pasteur, but so rare and little known that up to the present time it has certainly been often overlooked. When, instead of being heated to 175°, dextro-tartaric acid is heated in an autoclave for a period of fully two days up to 165° along with water, just as is done for the preparation of racemic acid, the latter is met with only in small quantities, while the larger proportion of the dextro-acid has disappeared. The racemic acid is first eliminated as much as possible from the liquid by crystallisation, and water is next added to the fluid, which is then divided into two equal portions; one of these is very carefully saturated with potassa, and this having been done is poured into the other portion, so as to form an acid salt. The acid potassa salts of the dextro-tartaric and racemic acids are not very soluble in cold water, while the inactive potassio-tartrate is very soluble, so that, when the liquid is partly concentrated by evaporation, the two first-named salts crystallise, while the third is deposited from the sufficiently-evaporated solution on cooling. This salt is purified by re-crystallisation; but as it is usually coloured in consequence of the decomposition of a small quantity of tartaric acid (owing to the high temperature), it is best first to add to the solution a few drops of acetate of lead, and then to treat it with sulphuretted hydrogen; the sulphuret of lead withdraws the colouring matter, and on filtration a clear and colourless liquid is obtained. The preparation of inactive acid can be carried on simultaneously with that of racemic acid by repeating the action of the heat a sufficient number of times to obtain the desired quantity of racemic acid, and to treat the mother-liquor thereof for the potassa salt of the inactive acid, which may by that means be obtained in quantities of from ½ to 1 kilo. of that salt, which may be converted by double decomposition into a lime salt, and decomposed by sulphuric acid, or into lead or copper salts, and decomposed by sulphuretted hydrogen. Professor Pasteur having kindly given me some of the inactive tartaric acid obtained by him in his experiments, I have been enabled to prove the identity of the two bodies. I intend to investigate this substance further. The conversion of inactive tartaric into racemic acid, and consequently into two tartaric acids possessed of double—right and left handed—rotatory power, appears to me interesting, as elucidating the ensemble of phenomena belonging to molecular dissymmetry. My observations are not absolutely in contradiction to the views now held on the origin of the rotatory power, because the inactive tartaric acid, which has been the starting-point, was obtained from dextro-tartaric acid, a native compound, so that it may be considered that the rotatory power of the latter has only been lost sight of, and has returned. We cannot, therefore, rigorously conclude on the possibility of reproducing by synthesis bodies possessed of rotatory power, and therefore I have gone farther, and hope shortly to lay before the Academy a communication of the results I have obtained by producing the complete synthesis of racemic acid by means of ethylen and cyanide of potassium—that is to say, artificially-made compounds obtained from the elements. —*Comptes Rendus.*

THE MANUFACTURE OF SULPHURIC ACID.*

By J. McCULLOCH.

(Concluded from p. 126.)

THERE are two methods at present in use on the Tyne for the denitration of the nitro-sulphuric acid; the Glover towers, and denitration by steam. The following is the system pursued by the steam process.

A cast-iron pipe 9′0″×3′0″ is lined with lead, and a lining of half thick bricks with pipe-clay as mortar; this is set on end and packed with flints, and a fire-clay pipe is connected between the top of this column and the chamber, a steam-pipe being introduced at the bottom; the nitro-sulphuric acid entering at the top trickles from thence down through the openings in the flints, where it is met by the ascending steam and reduced from 148° to about 104° T., and is raised in temperature from 60° to about 300° F., which on cooling down gives acid of about 128° T.

The acid as run from these columns generally contains only the faintest trace of nitrous compounds.

I have conducted chambers on this principle for a number of years, and for the last three or four years using about 24,000 tons of pyrites annually the average percentage of nitre has not been more than 3·5 per cent. The beauty of this system is that there cannot be a break down, as the denitrating columns can be detached from the chambers in a few minutes, and the chamber kept working by the addition of an extra supply of nitre.

The only drawback to this system at the present time is, that from three to four tons of coals are required per twenty-four hours to boil up as much weak acid as is required to absorb the hyponitric acid obtained from the conversion of twelve tons of sulphur into sulphuric acid.

The other system is the Glover towers; this no doubt is

* Read before the Tyne Social Chemical Society.

a very good system, but there are two serious drawbacks to it; first, the danger of the packing or lead giving way, necessitating the laying off the chambers; second, the re-absorption to a certain extent of the nitre in the columns. This is not such a serious obstacle where the acid is used over again in the Gay-Lussac columns, but where the acid is run direct from the denitrating columns to the decomposers, the loss must be very serious.

No doubt the saving in nitre is very great in manufactories where they have had no apparatus at work for the recovery of the hyponitric acid, but where they have had the first named system at work, and changed to the latter, I think it will be found that the percentage of nitre used on the sulphur will be considerably increased.

Let us examine the two systems closely. On starting a set of chambers, in the case of the steam columns, the steam and acid are turned on five or six hours before charging the burners with pyrites, the consequence is the chamber is entirely filled with nitrous fumes and vapour of steam, ready to begin work on the entry of the sulphurous acid.

I have charged burners at 6 a.m., and at 6 p.m., or twelve hours after, the drops at chambers have been at 130°; chamber a ruddy colour, and the following day the extra quantity of nitre could be taken off. The floor of the chamber was, of course, covered with acid to commence with. In the case of the Glover towers it is at least three or four days before the column is hot enough for denitrating purposes; there are no nitrous fumes in the chamber to start with, consequently there is a loss of sulphuric acid, and for a week at least an extra quantity of nitrate of soda is required.

In some works the nitrous fumes from the pots are conveyed through a separate pipe to the chambers, thus passing a current of pure sulphurous acid through the denitrating columns. This, I think, will not pay for the extra cost, as it is found in practice that heat alone will not drive off the nitrous fumes entirely. The nitro-sulphuric acid must be considerably weakened before it can be thoroughly denitrated.

A number of experiments were tried which gave the following results:—Five separate samples of weak acid were taken at 113° T., and on being calculated into oil of vitriol was found to contain 0·24 per cent $NaONO_5$.

These samples were passed separately through acid pans and evaporated from 113° to 152° T. at a temperature of fully 300° F.; on being cooled down to 60° F., and again calculated into O.V., the same acid was found to contain 0·22 per cent $NaONO_5$.

Another experiment was tried with a Glover tower, which was at the time only used as a cooling tower, owing to the absorbing plant not being ready. The weak acid at the top was at 110° T., and contained 0·32 per cent $NaONO_5$; after having passed through the tower it was found at the bottom to be 147° T., and contained 1·51 per cent $NaONO_5$. This, I think, goes a long way to prove that more than heat is required, and that the hyponitric acid is re-absorbed in the Glover towers.

The acid used for absorbing the nitrous fumes passing from the chambers should not be less than 148° T., and as cool as possible, although were it to be as high as 110° at the top of the absorbing towers, its power for absorbing would not be much affected, the column being kept in a very cool state by the cold ascending current from the chambers. Acid introduced at the top at 120° F. will be found, when drawn off at the bottom, to be as low as 60° F.

Much difference of opinion exists as to the erection and working of sulphuric acid chambers, such as the strength of the lead employed, the size of the chambers, necessary draught, strength of steam, &c.

In building a set of three or four chambers, the two first chambers should be of about 7-lb. lead, and the remaining chambers in the set about 6-lb. lead. The side straps in some works are bound to cross rails in the chamber framework, or nailed to the uprights. Both plans have been found objectionable, as on the stretching of the side sheets, the straps are either torn off, or should the lead be thin, pieces will be torn out of the solid sheets. The method which I have followed for years, and which I have found to be the best, is to burn a strap on each side of the chamber upright and clinch the two together in front, thus keeping the sides upright, and at the same time allowing the lead to sink or stretch, without putting a strain on either sides or straps. An objection may be raised that there is a danger of the sheets breaking away at the top; I have never known this to occur.

In working chambers, some prefer a large number of small chambers; others, a smaller number of large chambers. In small works where they have, say, only twenty or thirty burners, it may be convenient to have their chambers small, so that they may be able to lay off one or two for repairs; but in a large works I know of no point in their favour to recommend the erection of a large number of chambers, say, from 60'0" to 100'0" long, instead of from 120'0" to 180'0", with a corresponding height and width. Were the sides of the chamber found to condense more acid than the centre, it would be quite a different matter.

On that subject I agree with Muspratt, who says:—"Is it absolutely necessary that there should be a surface for condensation? Is this necessary in all cases, natural and otherwise? Does the rain cloud, which, perhaps, in one half hour will come down in a heavy shower, require a surface for condensation? If it did, possibly rain would be more manageable; but this watery vapour needs no cold surface; it condenses into water, losing the vaporous, and assuming the fluid state, without any assisting cold surface. And if this rain cloud be capable of so condensing, is it not possible for the like physical reaction to take place within a vitriol chamber? But further. Is it not probable, or rather certain, that the sulphuric acid in the chamber never was in the state of vapour. Sulphuric acid requires a heat of 620° to convert it into vapour. The highest point of heat a chamber could attain could be no approach to this; probably the heat of a chamber will not exceed 212° in the hottest part where the gas enters. Is it not possible that every atom of sulphuric acid produced passes from sulphuric acid gas to liquid sulphuric acid at once the instant it is formed—that the chamber is filled with these newly-formed particles—that these float about, and, like globules of running mercury, they gradually coalesce with each other, until at last they form a particle like a rain drop, sufficiently heavy to resist the sweeping influence of the currents which exist in the chamber, and that, finally, this drop falls into the acid on the floor of the chamber. Although it is impossible to see the process, and so prove the truth of this opinion, a very good inference of its justness may be drawn from an experiment which was tried on a chamber. A strip of lead about 3" wide was attached to the inner side of the chamber, in such a manner that it resembled a gutter or spout in an inclined position, one side of this gutter being formed by the chamber side, the other by the strip. This was placed about 2 or 3 feet above the acid in the chamber, and was about 9 feet long. In consequence of this position, the whole of the acid which formed or condensed on that side of the chamber above the strip would flow along it, and be carried by a small tube passing through the wall of the chamber into a vessel placed on the outside to receive it.

"If the liquification of the acid took place almost wholly on the side of the vitriol chambers, a pretty rapid current of acid must have flowed along this arrangement, but this was not the case; instead of, as might have been expected, a constant stream passing along it, nothing more than isolated drops issued, probably at the rate of six drops a minute, an utterly insignificant quantity, when compared with the amount of acid which must have been formed within the space over which this strip had the command. In fact, any observant manufacturer must, after a little attention to the subject, come to the conclusion that such is the case; that condensation goes on chiefly within the

space of the chamber, although a small portion may condense on the walls; for when the acid particles are floating about in the chamber, driven hither and thither by the various currents which must exit—some must attach to the sides and flow down into the acid already at the bottom, adding to the amount already formed. But the argument remains that all the acid is not brought to the liquid state by this means; that, in fact, the quantity so formed bears a very small relation to the whole.

"To many this will be already palpable, but evidently not to all, inasmuch as these strange abortions of chambers are not by any means as yet extinct, but still remain a testimony to the ignorance of many of our manufacturers. It must be apparent, that if anything more than the usual amount escapes from the chambers, either they are badly worked or overworked. If the first should be the case, more attention must be directed to them to find out the error. If the second suggestion be correct, then as the chambers have more material introduced into them than they can properly work, the amount of sulphur usually burnt must be decreased, until the maximum amount which can be burned with a beneficial result is found. It needs little argument to prove that the working space included in a tunnel could have been included in the chamber at much less expense."

Some acid makers have the idea that small chambers are necessary for the proper mixing of the gases; this idea will not, however, bear investigation, for between the currents which exist in the chamber, from condensation, draught, and the law of gaseous diffusions being in force, it is impossible that free oxygen, binoxide of nitrogen, hyponitric and sulphurous acids can exist separately, however large the chamber may be.

In working chambers much has been said about the rule of three and rule of thumb methods of ascertaining the quantity of nitrate of soda contained in the sulphuric acid. Much as I admire the rule of three, I think that a rough and ready method of calculation will oftentimes give the manager quite as satisfactory results, is much better than spending time in the laboratory which might be more beneficially employed, and it frequently occurs that the expected rule of three merely proves a rule of thumb method after all. Let us examine the subject fairly and practically. For a number of years I worked a set of chambers, which, when wrought with nitre alone never took more than 9 per cent nitre, burning seven tons of sulphur per twenty-four hours from pyrites. When using the Gay-Lussac towers and denitrating the nitro-sulphuric acid by steam, I used 3·5 per cent nitre, and passed 52·497 lbs. of acid through the denitrating columns per twenty-four hours.

The acid I have had tested repeatedly, both by the urea and permanganate processes, and it was always found to contain more than 6 per cent of $NaONO_5$. Now if we take the acid as containing 6 per cent, it will give us 3,149 lbs. of $NaONO_5$, which, when added to the 3·5 per cent of nitre used from store would equal 23·5 per cent of nitre on the sulphur charged. On trying to reduce the quantity of acid passed through the denitrating column, the chambers began to get pale, and I had at once to put an extra "run" on them, thus showing that there could not possibly be the quantity of $NaONO_5$ in the acid as shown in the analysis.

All that is needed in working chambers is an approximate idea of the quantity of $NaONO_5$ contained in the sulphuric acid, and by putting a little hot water into the acid from the absorbing towers, the manager can at once tell whether the acid is "rich" or "poor," and take measures accordingly.

I have here a ground plan of six chambers, somewhat similar to a set which I worked for five years (minus the Glover towers); the working chambers never attaining more than 160° F., and the receiving chamber 90° F. These chambers, measuring 180'0" × 21'0" × 20'0", were worked at 28 cubic feet per pound of sulphur per twenty-four hours, and gave an average production of 284 per cent O.V. on sulphur charged.

There are forty burners attached to the six chambers, divided into two sets of twenty burners each. The gas from the first twenty burners passes through a Glover tower into No. 1 chamber, traversing which it enters No. 2, thence through a damper into the draught pipe "A," which carries the gas into No. 5 chamber, thence to No. 6, which it leaves by the draught pipe "B," through two dampers, "C C," to two absorbing towers. The advantage in having two dampers placed here is, that in case one column requires repairs, the damper can be shut, and the other column will work the six chambers in the interval.

The gas from the second twenty burners passes through a Glover tower into No. 3 chamber, thence to No. 4, leaving which it passes through a damper into the draught pipe "A," pursuing the same course as the gas from chambers Nos. 1 and 2. The advantage in working chambers on this system is, that although there are only six chambers the gas from each set of burners passes through four of them, thus making the six chambers almost equal to two sets of four chambers each.

There is also another advantage in the case of repairing either Glover towers, or Nos. 1, 2, 3, or 4 chambers; the damper at the end of 2 or 4 can be put down, when there is a complete set of four chambers in either case. If necessary heavier charges of pyrites can also be introduced into the twenty burners that are working, as there will be a larger chamber space.

I have found over many years experience, that the best draught to work chambers with, is—when the manhole door is opened, the gas as it were did not know its own mind; it would fain come out, but it would just as soon stop in. This happy medium cannot, however, be always attained, as the chamber draught must be regulated to suit the burners. To obtain a good production, the strong chamber drops should not be kept above 130° or 135°, the weak chamber about 100° T., and the steam should on no account be high pressed; it should never be above 12 lbs., 11 lbs. I consider a good standard at the boilers with the allowance of a pound either way.

PROCEEDINGS OF SOCIETIES.

GEOLOGICAL SOCIETY.

March 12th, 1873.

JOSEPH PRESTWICH, Esq., F.R.S., Vice-President, in the Chair.

The communications read included the following:—

"*On Solfataras and Deposits of Sulphur at Kalamaki, near the Isthmus of Corinth.*" By Prof. D. T. ANSTED, M.A., F.R.S., F.G.S.

After noting the traces of volcanic action east of the Pindus chain, the author described the Solfataras and sulphur-deposits of the neighbourhood of Kalamaka as furnishing indications that there is even now a real though subdued volcanic energy in this part of Europe. At this place, about three miles east of the Isthmus of Corinth there is a series of cream-coloured and grey gypseous marls, broken by narrow gorges and fissures. These marls, the stratification of which is much disturbed, are loaded with sulphur. In the principal gorge there are several lateral fissures, forming caverns, communicating with the interior by deep cracks; these caverns are completely lined with crystals of sulphur and other volcanic minerals, and are rendered inaccessible by the large body of hot stifling vapours constantly emitted through them. The temperature of this vapour, where it can be reached, is about 100° F., but the floor of the caverns is too hot to stand on even near the entrance. The author is of opinion that the rocks in this gorge might be profitably worked for sulphur. Similar phenomena occur in several other places within about a mile of

the ravine described; and the author was informed that this was the case also several miles further to the east.

The author adverted to other signs of volcanic action to the west of these Solfataras, and especially to the structure of the Acropolis of ancient Corinth, and inferred that lines of volcanic action parallel to the spurs of the Alps of which Etna and Vesuvius, and Santorin are the modern vents, ranged far to the north at no distant period.

Mr. W. W. SMYTH wished that the author had drawn a more distinct line between the tertiary beds containing sulphur and those of still more recent origin. The beds near Corinth reminded him much of some in Transylvania, and he was anxious to know whether the direction of the fissures or other phenomena indicated any great disturbance of the strata.

Prof. ANSTED, in reply, mentioned that the fissures ran approximately north and south, and were as nearly as possible parallel. He considered that they were connected with the disturbances which have taken place in comparatively recent times along the eastern coast of the Morea. The sulphur, which usually occurs in small globular masses in gypseous beds, was found in these Solfataras in crystalline form, and in connexion with the fissures from which the heated gas issues. There was therefore a marked difference in the manner of its occurrence both in Italy and Greece. In Greece the sulphur deposit in nodules was found on the west of the principal chain of mountains, and the crystalline sulphur on the east. In Italy the crystalline sulphur is limited to the vicinity of Vesuvius, and the nodules are abundant both in Sicily and on the east coast of the main land.

"*On the Origin of Clay-Ironstone.*" By J. LUCAS, Esq., F.G.S.

The author commenced by giving a general view of the varieties, chemical composition, and mode of occurrence of clay-ironstone, and suggested that the formation of all the bedded varieties may be explained by the supposition that they originated in peaty or non-peaty lagoons on the alluvial flats of the deltas of the carboniferous formations, which would present semi-terrestrial conditions, that is to say a surface exposed to the air, but subject to be covered by floods. Carbonic acid formed in the lagoons from decomposing vegetable matter, meeting with protoxide of iron in solution, would unite with it to form carbonate of iron, which, with the mud of the lagoon, would produce clay-ironstone. Thus, in the author's opinion, the beds of clay-ironstone, like coal-beds, mark terrestrial horizons. The author supported his views by reference to various sections, and also cited the occurrence of what he regarded as an analogous phenomenon on a small scale in some mud obtained from the shore between Redcar and Saltburn.

Prof. ANSTED thought that the explanation offered by the author, though satisfactory for instances of limited thickness and confined area, was not equally applicable to the far larger deposits, such as those in America, extending over hundreds of square miles, and many times as thick as those described. The beds had by some been considered as due to segregation subsequently to their deposit; but this view also seemed hardly such as could be generally accepted. The deposits of ironstone varied much in character, sometimes consisting of layers of distinct nodules, and in some cases of continuous bands. The origin of each of these classes appeared to him to have been different, and in some of the coal-deposits the ironstone bands were present on a more extended scale than seemed consistent with the author's theory.

Prof. RAMSAY thought that the paper exhibited considerable ingenuity, and that the examples given by the author were intended by him to be equally applicable to large areas. The estuarine character of much of the coal-deposits was an acknowledged fact; and the theory proposed by the author was quite in accordance with such a state of things. He did not agree with him that ironstone was never deposited in marine strata, as they occurred in the Yoredale beds and in some Liassic beds. As to the deposits of ironstone in fresh water, he referred to those still taking place in some of the Swedish lakes.

Mr. FORBES, whilst admitting that in many instances clay-ironstones had been deposited in circumscribed waters or shallow lakes, as is the case with the lake iron-ores in Sweden now actually in process of formation, pointed out that some of the largest clay-ironstone deposits in England, those of the Yoredale series, contained marine fossils in abundance. On chemical grounds it is not clear in what state of combination the author imagines the iron to be held in solution previous to having been, according to him, converted into carbonate of iron, by meeting with the carbonic acid formed in the lagoons from decomposing vegetable matter; and further, the mere fact that the Saltburn mud effervesced with nitric acid after having been bottled for some days, must not be regarded as necessarily proving the formation of carbonate of iron in it.

Mr. CHARLESWORTH called attention to the nodules of ironstone which were found in the coprolite diggings in Suffolk, as to the origin of which little was known. The banding in the interior of these nodules was posterior to their formation, as was evinced by its following the contours of the exterior, and even of lithodomous borings in them.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

THE following is the Inaugural Address of Dr. LUNGE, the President for the present Session:—

In rendering you my thanks for conferring upon me the distinguished honour of election as your President for the coming session, I do not see any reason for deviating from the custom of my predecessors in this office, to pass shortly in review the labours of the past session. When preparing to do so by re-perusing the reports of our *Transactions* throughout the last winter, I was struck in the first instance by the observation, that, if the papers contributed by our members were few in number, most of them certainly were very valuable, partly by their own contents, and partly by the suggestions that might be derived from them for a further development of the investigations then commenced. It cannot but be the case in a chemical society of a local character, like our own, that the subjects taken up by our members are almost exclusively derived from technical chemistry, and more particularly from such branches of this science as are the speciality of this district. So far from regretting this circumstance, I believe that this is just as it ought to be. In manufacturing on a large scale, problems constantly arise which are almost unknown to the metropolitan student working in his laboratory, and the investigation of such problems is not only of a practical, technical, and economical importance, but it cannot fail to have substantial results of a purely scientific character. This will be all the more assured, of course, if those who take such matters in hand do not confine themselves merely to work on till they have remedied certain irregularities or defects found in manipulating chemical reactions on a large scale; but if they continue their researches till they completely elucidate the *rationale* of the regular process, as well as of any deviations from this observed by them, they will thus, in one and the same act, put themselves on a scientific basis, and aid even their immediate purpose infinitely more than by merely confining themselves to looking at the matter from the manufacturer's point of view. It is quite certain that we cannot do better than encourage to the utmost all efforts tending in this direction; and on this account we have reason to be specially thankful to Mr. Moorhouse for his paper "On the Action in the Black Salt Pan and Carbonating Furnace." The second point which struck me came out very prominently just in connection with this paper, although it appeared also on all other occasions, viz., the way in which both the utility

of the papers read before this Society is enhanced, and the general interest in them is kept alive by the discussions following the reading of them. I believe I am correct in stating that the facts elicited in discussion, partly from the authors of the papers and partly from others, often nearly approach the papers themselves in value, and may sometimes even exceed them in that respect. I must certainly congratulate the Society upon the plan it has been following, of having the discussions reported and printed *in extenso*, and I hope that this plan can be even improved by regularly arranging the discussion upon any paper to follow at the meeting held next to the reading of it, without, of course, excluding any remarks that may spring up directly after the reading. It has been proposed, as an alternative to this plan, that the papers should be printed and in the hands of the members before the day of the meeting at which they are read, so that a discussion could with advantage succeed them at once; but apart from the great difficulty of getting authors to supply their contributions such a long time before the meeting as would be necessary for printing and distributing them, it also seems hardly fair to me that an author should be deprived of the freshness of the impression to be produced by his work, by the fact that everybody knows beforehand what he is going to say; the reading itself would then be nothing but a ceremony which might be dispensed with altogether, and that surely is not desirable.

The value of a discussion was proved very distinctly in connection with the very important paper, contributed by Messrs. Pattinson and Freire-Marreco, "On the Residual Sulphur in Purified Coal-Gas," with the translations of Fresenius's methods for analysing superphosphates; and last, not least, when the two papers were read which in their entirety constitute the most important contribution to technical chemistry sent forth by our Society last session, viz., the description by Messrs. Gibb and Gelstharpe of their new mechanical calcining furnace, and of their new process for obtaining a precipitant and manufacturing alkali from waste solutions of copper extraction. As you no doubt all remember the very great interest awakened by these papers in the Society, and the universal appreciation they found amongst us, I need not say anything more about them. No discussion has as yet been opened upon the paper with which our last winter's meetings closed, viz., that by Messrs. Clapham and Ball, "On Bachet's Method for Manufacturing Caustic Soda." We shall open our practical work with that task for which the interesting and suggestive paper referred to will no doubt give ample opportunities.

In turning from what we have done to what we may do next, it seems to me as if there were quite unusual opportunities for our own members of both benefitting themselves and others by investigating the new processes constantly coming out in the wide range of alkali manufacturing. I do not think that at any previous time such a host of new processes has been proposed in that branch of technical chemistry. For the last two or three years one patent has followed another in rapid succession; and although we are quite used to finding a very few grains of fertile seed among a great heap of chaff, where patents are concerned, yet there were such great expectations held out of complete revolutions in alkali-making, even by thoroughly practical men, that it quite took away one's breath. What between Messrs. Hargreaves, Young, Weldon, and Deacon, not to mention any others, nearly all the time-honoured plant of alkali-works seems to be doomed to destruction. No more acid chambers, nitre ovens, Gay-Lussac towers, decomposing pans, chlorine stills, condensers, bleaching-powder boxes, as we all know them; and now Messrs. Gibb and Gelstharpe want even to do away with our very stronghold, the ball-furnaces. Somehow or other the great revolution has not yet been accomplished; the old plant is still in existence everywhere, only augmented here and there by an appendix, according to Weldon or Deacon. But it would be idle to deny that very likely a great change is really impending, when the chaos of inventions and proposals will have been cleared up, and just at this point the work of our Society ought to make itself felt. The clearing up of that chaos will be an immensely tedious and costly process, if it is to be done exclusively by the rule of thumb, by putting up plant in twenty factories, and trying whether in the long run it "pays" or not. Most certainly that stage must also be gone through; but it can be shortened and cheapened very much indeed, if the new processes are thoroughly watched and followed out with a scientific spirit by those set to superintend them; and the latter, when communicating their results to this Society, will most assuredly not only benefit others, by either saving them needless expenditure of time and money, or encouraging them to go in for a real improvement, but, on the other hand, they will be benefitted to no small extent by the discussions, which will in many cases throw a flood of light upon points which are dark to them, and which have puzzled them for a long time, and they will no doubt receive many a suggestion amply repaying them for the trouble they have bestowed upon preparing their papers for this Society. This is so self-evident that I surely need not say another word in commendation of the practice of communicating the results which our members may find in working any new processes they may be using. Nobody can be more useful in this respect to the Society than a great many of our junior members, who personally superintend the introduction and working of such processes, and I trust they will come forward liberally this session with communications of the observations they have made and the results they have obtained.

Very much in the same direction tends a proposal which has been made during the last few months, and which has been most warmly commended by one of our own members, viz., the formation of an Association of Chemical Manufacturers, with yearly general meetings to be held in the centres of chemical industry turn by turn, and with frequent meetings of the local sections. Our own Society cannot in any case merge in such an Association, because, after all, its scope is somewhat different from that of purely technical chemistry; for even though, from our local circumstances, the latter will always form the chief, yet it will not and ought not to form the exclusive, subject of our "Transactions;" and, moreover, our Society ought to place even such manufacturing details as are submitted to it, and discussed among its members, into an atmosphere of scientific research, which in an Association of Manufacturing Chemists would certainly recede into the background. I have already stated the truism that the practice of manufacturing itself will ultimately gain very much by the treatment of its details in a scientific spirit. From this reason the presence amongst us of chemists, other than manufacturing ones, is of the greatest possible benefit, and I believe we shall have to try utilising their theoretical knowledge more than we have hitherto done. But so much is certain, that an Association such as proposed would be a most beneficial thing for all concerned; and I am sure I am expressing the thoughts of the Newcastle Chemical Society in general, if I express my best wishes for the success of the proposed Association, and my hope that our individual members will further it to the best of their powers.

You will, perhaps, pardon me if I follow up these general observations with the description of a new process for manufacturing alkaline carbonates, for which I took out a patent some years before the great tide of new processes set in, which, however, was not carried beyond the first term of three years. I must premise the following remarks. The process was a practical success, not only in the laboratory, but on a moderately large scale, but it was never carried out so as to become a current-going manufacture. The reasons for this do not concern us here, but they were foreign to the technical character of the process, and had nothing to do with its practical success or failure; the same reasons led also to the abandonment of the patent. As practical men most of you will readily under-

stand why I did not, under such circumstances, think it wise on my part to draw public attention to my process, till it should have been carried out on a large working scale, and practically introduced as a working concern; but this, of course, was hardly to be expected at all, when the patent had lapsed. From this circumstance, I dare say, very little notice has been taken of my process, without any judgment being given thereby upon its merits; and now that my individual interest in it as a patent has ceased long since, I am encouraged to give it forth to the world, in the hope that some parts of it at any rate may give suggestions, or form starting-points for new inventions and improvements in other processes. I have no doubt that other parts again will meet with your criticism, and I am myself conscious of some weak points, but I shall not only not resent any critical remarks, but I distinctly court them, If, by giving in such manner greater publicity to my proposal, I somewhat increase the chaos I have spoken of before, it is with a view of supplying a little more material out of which ultimately a perfect alkali-making process may be evolved. I must also remark that, although in the following description I am exclusively speaking of sodium compounds, yet everything said about them equally applies to potassium compounds. This is almost a matter of course, and it has been borne out by experience, at any rate in laboratory experiments.

The first idea of my process was given to me by a proposal emanating from the well-known Professor Wagner, the author of those most valuable annual reports on chemical technology published in German. Wagner had for a considerable time past given a great deal of attention to the "baryta industry," and had also tried to introduce it within the circle of alkali-making. It is well known that solutions of sodium sulphate cannot be completely decomposed by barium carbonate, whatever the temperature and the degree of concentration may be. Wagner found, however, that barium bicarbonate acts differently, and based upon this a proposal for a new method of converting sulphates into carbonates of sodium and potassium. This prescription was to stir up barium carbonate in water, and conduct a current of carbonic acid through the milky liquid till it becomes clear, barium bicarbonate being formed; to this he added an equivalent quantity of sodium sulphate, and thereby obtained barium sulphate as a precipitate, and a solution of sodium bicarbonate. Later on he found that not the whole of the barium carbonate need be converted into bicarbonate in order to make the decomposition of the sodium sulphate complete. Dr. Hofmann, in his report on the International Exhibition of 1862, remarks, with reference to this proposal, that the celebrated French alkali manufacturer, M. Kuhlmann, had not found it to be practicable on a manufacturing scale, but had got better results by working under a pressure of four or five atmospheres. Evidently Kuhlmann did not pursue his experiments with Wagner's proposal much further, because such a pressure would be both awkward and costly to maintain on that large scale, which is the rule in alkali-making; for this reason alone, the process, as it then stood could never have been expected to supersede Leblanc's process. There are, however, other drawbacks to Wagner's proposal, which must be quite evident to any practical manufacturer, and must deter him from carrying it out. The solution of barium bicarbonate is at the best a very dilute one, and of course correspondingly so the resulting solution of sodium bicarbonate; this would produce an expense for fuel in boiling down the liquids which must be fatal to the process. According to Gmelin, 1 part of barium bicarbonate is soluble in 830 parts of water. This proportion is somewhat improved, but remains still very unfavourable, by following Wagner's later proposal to convert only a portion of the baryta into bicarbonate; how much is not stated. The favourable effect of great pressure observed by Kuhlmann admits of an easy explanation, since, under pressure, water dissolves a larger proportion of barium bicarbonate. Apart from the expense of fuel for evaporation, such dilute solutions require an immense amount of plant and space for manipulating with. Then, again, it is clear that a large portion of the carbonic acid will pass through the liquid without being absorbed and will be lost; and a most serious obstacle to the whole proposal is that the whole obtainable quantity of native barium carbonate (witherite) is extremely trifling in comparison to the immense extent of alkali-making. So long as the proposal was not complemented by an easy and cheap method of recovering carbonate from sulphate of barium it was entirely barren and useless.

Now, in thinking over these various drawbacks, and considering how they could be avoided, I at last hit upon a combination of various reactions, which seemed to me to form a complete cyclus, and to lead to an economical and practicable solution of the problems of utilising the reaction between barium bicarbonate and sodium sulphate. In the first instance, instead of beginning by making a solution of barium bicarbonate and adding sodium sulphate thereto, I began by making a strong solution of the latter (commercial sulphate of soda) at the ordinary temperature, say 1 part of sulphate to about 12 parts of water. In this I suspended barium carbonate, but not the native witherite, of which a very large excess would have been required, but an article artificially prepared in a manner to be described hereafter. Through this mixture I sent a current of carbonic acid, obtained in any suitable way, but the purer the better. I will call the vessels in which this reaction takes place "converters." Each converter ought to be provided with an agitating shaft, in order both to keep the barium compounds suspended throughout the whole contents of the vessels, and to divide the current of carbonic acid into the smallest possible bubbles. For the latter purpose, any further suitable and usual means might be employed. Each particle of barium carbonate as it is converted into bicarbonate, and thereby becomes soluble, must instantly act upon the sodium sulphate present in solution, the result being the formation of sodium bicarbonate and barium sulphate. The former, being a soluble salt, remains in solution; the latter, being insoluble, is precipitated. Since, therefore, the barium carbonate, as soon as it is generated, is instantly removed again from the liquid by being converted into insoluble sulphate, the liquid is directly after again ready to receive a fresh quantity of barium bicarbonate, which in its turn is removed forthwith as sulphate, and thus the reaction goes on continuously till there is nothing in solution but sodium bicarbonate and any soluble impurities of the original sulphate of soda employed; the precipitate, on the other hand, containing an exact equivalent of barium sulphate and any employed excess of barium carbonate. In the case of artificially prepared, *i.e.*, precipitated barium carbonate, it is not necessary to use more than the quantity required by theory; but if native witherite be used, at least four times the theoretical quantity must be taken. A very trifling quantity of barium bicarbonate may remain dissolved; but it is completely removed during evaporation, when the second equivalent of carbonic acid is driven off, and barium carbonate falls down. My theoretical reasoning was completely borne out by the practical test of experience. Starting with a few ounces, and proceeding to several hundredweights in one operation, I always found that I could convert *all* sodium sulphate into bicarbonate, and that, if the carbonic acid was tolerably pure, and was employed in a strong current, and if the liquid was well agitated, three or four hours sufficed for the completion of the reaction. I always worked at the ordinary temperature of the air, and under no extra pressure; but in working on a continuous manufacturing scale, if my arrangement of apparatus were adopted, there would be in the first converter a pressure of about 15 lbs. to the square inch, which would be decidedly beneficial to the operation, without causing any practical working difficulty to speak of. In my patent specification, I of course provided for all manner of things, such as the employment of "scrubbers" in the place of "converters"

with agitating shafts; but, in practice, I always used the "converter" as described, and I still think it the best means of working. It need hardly be mentioned that the time for stopping the reaction can be most readily ascertained by taking a sample out of the converter from a pet-cock, getting some clear liquid from it by filtration or subsidence, and trying, by a solution of barium chloride, whether any more sodium sulphate is present. Nor is it necessary to dwell upon the separation by settling and washing of the dissolved sodium and the precipitated barium compounds, this operation being a very easy one, as the precipitate is of a very dense nature.

(To be continued.)

MISCELLANEOUS.

Pyrology.—Major W. A. Ross, who read a paper on this subject before the Royal Society (see CHEMICAL NEWS, vol. xxvii., pp. 67, 78, 87), is preparing a volume of some 500 pages on the same subject. The work will be published by Messrs. E. and F. N. Spon.

The Royal Polytechnic.—The subject of Prof. Gardner's new lecture at this institution is "Fuel." The lecture is fully illustrated by experiments, and contains much valuable information and many useful hints on a subject of present importance. An interesting lecture entitled "The Worlds Above," is illustrated by some peculiar optical, spectral, and dioramic effects, invented and adapted by Dr. Croft, one of the directors of the institution.

London International Exhibition, 1873.—The fifth meeting of the Committee on Surgical Instruments and Appliances took place on the 18th inst., at the Royal Commission Offices, Gore Lodge. The following members were present:—Mr. Cæsar H. Hawkins, F.R.S., in the chair; Mr. W. White Cooper; Mr. H. J. Domville, C.B., M.D.; Dr. Arthur Farre, F.R.S.; Dr. G. T. Gream; Mr. J. Hilton, F.R.S.; Mr. J. Hinton; Mr. R. Liebreich; Mr. J. Luke, F.R.S.; Mr. A. E. Mackay, M.D.; Mr. J. Marshall, F.R.S.; Dr. W. S. Playfair; Mr. E. Saunders; Mr. E. Sercombe. The Committee examined the instruments which had already arrived, and accepted the majority of those submitted for approval. They formed sub-committees for the purpose of examining the different classes of the instruments and appliances, and agreed that they should meet weekly until the Exhibition should open. It is, therefore, hoped, that all the arrangements will be completed before the 8th of April, so that a clear week for private views and the visits of reporters may be allowed before Easter Monday, when the collection will be thrown open to the public.

Testimonial to Dr. Bence Jones.—At a meeting of the Managers of the Royal Institution, held on Monday, March 10, 1873, specially to consider a letter from Dr. Bence Jones, resigning his office as Honorary Secretary, the following Resolution was unanimously agreed to:—"The Board of Managers receive with deep regret the letter of Dr. Bence Jones containing his resignation of the office of Secretary to the Royal Institution. They lament the reason which compels him to relinquish a post which he has filled for so many years with equal honour to himself and advantage to the Institution. His conviction of the value of original research, and of the special vocation of the Royal Institution to continue diligent in promoting it, was with him an unceasing stimulus to exertion. His attention to every detail left nothing neglected in the performance of his duties. His own scientific attainments have been of signal effect in maintaining respect for the Institution, and in procuring the co-operation of eminent men in the Laboratories and Lecture Theatre. His love of the place and its memories has been shown by the pains he took to collect its early annals,—including in this work an account of the discoveries of Young and Davy,—and by his becoming the historian of Faraday. The Managers cannot fail to remember that the services of Dr. Bence Jones have been given under the pressure of important professional engagements, and latterly, under the additional difficulties of failing health; and that until now, reluctantly compelled to resign, he has never relaxed in the active prosecution of his honourable task. The Managers, however, trust, that the aid of Dr. Bence Jones may not be altogether lost to the Institution; but that he will still afford to it the benefit of his counsels and experience. They hope that he may in future occupy a seat at the Board of Management; and further, that he will remain associated with the Institution, by doing it the favour of accepting the position of Honorary Assistant Secretary. They believe that the distinguished success which has attended Dr. Bence Jones in his career as Secretary will always be his worthiest reward. It rests with them to tender to Dr. Bence Jones the expression of their strong personal regard, and of their warmest gratitude for his invaluable services to the Royal Institution." It having been ascertained that the form of Testimonial most agreeable to Dr. Bence Jones would be a bust of himself to be placed in the Royal Institution, the Managers resolved to open a Subscription List among the Members of the Royal Institution for the purpose. Individual Subscriptions to be limited to £3 3s. as a maximum. Subscriptions to this Testimonial may be paid either at the Royal Institution, or to "The Dr. Bence Jones Testimonial Account," at Messrs. Drummonds, the Bankers, Charing Cross, who are authorised to receive the same.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, March 3, 1873.

Contains the following original papers and memoirs more particularly relating to chemistry:—

Action of an Electric Current upon a Mixture of Equal Parts by Bulk of Carbonic Acid and Proto-Carburetted Hydrogen (Marsh-Gas).—P. and A. Thenard.—The detailed account of a mode of experimenting, the result of which has been already quoted. The authors state that this communication is only preliminary.

Researches on the Saline Decompositions.—L. Joulin.—This monograph treats on double decomposition, and is divided into the following sections:—Carbonates; salts of manganese; excess of one of the salts; influence of the temperature; other metallic salts; velocity of the reactions; phosphates; borates. As regards the carbonates the following is the result arrived at:—The reaction between carbonates and metallic salts yields (irrespectively the property of the oxides to form or not to form hydrates) mixtures of carbonates and of oxides of the metals, generally in indefinite proportions; and this holds good for all degrees of dilution of the alkaline carbonate, but only for a certain degree of dilution of the metallic salt when in excess. The quantity of oxide increases with the degree of dilution and the temperature. The metallic carbonate is decomposed by the alkaline carbonate which has not yet entered into combination.

Researches on the Occlusion (Dissolution) of Gases in Pig-Iron, Steel, and Wrought-Iron.—L. Troost and P. Hautefeuille.—This paper, the continuation of a memoir on this subject, treats in the first place on the absorption of hydrogen by cast-iron when molten in a scoop made of charcoal, and kept at a very high temperature. The gas is absorbed in rather large quantity, but on cooling it is given off again, giving rise to spirting of the still fluid metal. Carbonic oxide is not perceptibly absorbed. Next an account is given of a series of results of experiments on the gases occluded from cast-iron, soft wrought-iron, and steel; first in their usual condition, and next after saturation of the metals; the gases operated with being hydrogen and carbonic oxide. It appears that the metals also absorb some nitrogen and carbonic acid.

Modifications of the Spectrum of the Chlorophyl under the Influence of Alkalies.—J. Chautard.

Application of Concentrated Ozone as a Reagent upon Organic Substances.—Ozobenzine.—A. Houzeau and A. Renard.—After several observations on the action of ozone and of oxidising substances, this memoir treats on the action of ozone upon benzine. Among the products of this reaction the authors call particular attention to ozobenzine, an amorphous, solid, white-coloured substance, which is dangerously explosive—a decigramme being sufficient to cause damage to buildings. The compound is, however, very unstable, becoming converted into a fluid which contains acetic acid. Ozone (that operated with by the authors contained 60 miligrammes to the litre of oxygen) mixed with bicarburetted hydrogen (ethylen, C_2H_4) gives rise to an instantaneous and violent explosion, accompanied with vivid combustion even at the ordinary temperature, and in the dark (absence of sunlight); but no reaction at all was observed between ozone and hydride of methyl, $C_2H_4C(CH_4)$.

On Anthracenamine.—Dr. T. E. Phipson.—See CHEMICAL NEWS. vol. xxvii., p. 97.

A Derivative from Tetra-Chloride of Naphthaline.—E. Grimaux.—The second instalment of an exhaustive essay on this subject, elucidated with a series of formulæ.

March 10, 1873.

Contains the following original papers and memoirs relating to chemistry:—

Density of the Vapour of Perchloride of Phosphorus.—A. Wurtz.—The contents of this lengthy essay, elucidated by a series of tables exhibiting results of experiments, may be summarised as follows:—The normal vapour-density of perchloride of phosphorus is that of a non-dissociated atomic combination. When two volumes of vapour of the protochloride contain 3 atoms of chlorine to 1 atom of phosphorus, two volumes of vapour of perchloride contain 5 atoms of chlorine for 1 atom of phosphorus. There is no reason to suppose that 2 of these 5 atoms of chlorine should differ from the 3 others. The whole 5 are combined with 1 atom of phosphorus, and the 6 atoms so united form the atomic combination which constitutes the perchloride of phosphorus, while the phosphorus only manifests three atomicity in the protochloride—a non-saturated combination—and also in the phosphuretted hydrogen. The phosphorus exhibits pentatomicity in the perchloride of phosphorus.

Industrial Production of Cold by Aid of the Expansion of Permanent Gases, and more Especially Air.—J. Armengaud.—The detailed description of the process and mechanism by which this object is attained.

Experiments on Putrefaction, Disinfection, and the Preservation of Organic Substances.—M. Laujovrois.—According to the author's researches fuchsine—1-100th part—has the property of acting both as a disinfectant and as an antiseptic; while aniline violet is stated to be even more active in preserving nitrogenous substances.

Assimilability of Phosphates.—H. Joullie.—The action by double decomposition of oxalate of ammonia upon phosphates (native more particularly), and the more or less solubility of the same in acetic acid, is considered by the author to give a clue to their assimilability by plants.

Benzylated Naphthaline.—Ch. Froté.—The author records at length, and elucidates by formulæ, the results of the reactions of chloride of benzyl, naphthaline, and metallic zinc aided by heat. The benzylated naphthaline is a solid, colourless substance, insoluble in water, very soluble in ether, fusion-point 64°, formulæ, $C_{17}H_{14}$.

Combination of Urea and Chlorated Acetyl.—D. Tommassi.—This memoir, elucidated by a large number of complex formulæ, treats on a new compound, chloracetyl-urea, a solid, crystalline, colourless body, insoluble in cold, slightly soluble in hot water, readily soluble in alcohol, partly decomposed, partly sublimed, unaltered at about 160°; simplest formula—

$$\left.\begin{matrix} CO'' \\ (C_2H_3ClO)'H \\ H_2 \end{matrix}\right\}N$$

Memoir on the Composition of the Raw Sugars.—Third Produce (from Beet-Roots) and on the Commercial Analysis of the Same by the Estimation of the Ash they Contain.—Ch. Violette.—The contents of this essay bear more particularly upon the beet-root sugar-making process.

Observations on the Composition of Guanos, on their Alterations, and on the Probable Origin of the Fossil Phosphates of the Lot District (France).—A. Baudrimont.—The most salient point in this paper is the opinion that the phosphatic minerals of the Lot district might have been derived from ancient guano deposits.

Saccharine Matter Contained in Mushrooms.—A. Müntz.—This paper contains, in the first place, a *resumè* of the labours and researches of Braconnot, Mitscherlich, Sacc, and others on the saccharine matter contained in different species of mushrooms: next, the author records his researches, from which it appears that some species of these cryptogams do not contain *Agaricus campestris*, for instance, mannite, nor also trehalose; while again the *A. muscar.*, which is very poisonous, and contains 10 per cent of trehalose only.

This number contains further a large number of papers relating to mathematics, astronomy, meteorology, physiology, natural history sciences, and palæontology. Among the latter attention is called to—

Existence of Man During the Glacial Epoch in Alsace.—Ch. Grad.

La Revue Scientifique de la France et de l'Etranger, March 8, 1873.

Contains no original papers on chemistry.

Bibliography.—"Les Animaux Fossiles du Mont Léberon, Etude sur les Vertébrés Fossiles," par M. A. Gaudry; Paris: Savy éditeur, 1873. A very important addition to palæontology. The locality named is situated in the south of Fraace.

March 15, 1873.

Contains no original papers relating to chemistry, but attention is called to a memoir on—

Propagation of Heat in Crystalline Bodies.—E. Jannetas.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, January 23, 1873.

Contains no matter relating to chemistry, but attention is called to the following papers:—

Machinery for Sharpening Saws.—M. Baras.—The account of a contrivance by which saws are rapidly and uniformly sharpened.

Improved Pressure-Gauges.—J. Brau.—The improvement mainly consists in an arrangement for illuminating these instruments by a source of light placed in the interior.

Bibliography.—"Les Plantes Etudiées au Microscope," par J. M. Girard; Paris: Hachette et Cie. An excellent book on micro-phyto-histology.

January 30, 1873.

Filter for Water.—M. Henry.—The description of a contrivance useful for the filtration of water for domestic purposes.

Gas Regulator; Pressure Regulator.—J. Maldant.—The account of a mechanism suited for the purpose of so regulating the gas supply to the burners that the combustion is complete; and excess of air as well as of gas avoided, thereby producing a considerable saving in the consumption of the latter.

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C., and 8, Houndgate, Darlington.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

538. C. Burfit, New Wimbledon, Surrey, "The manufacture of a new composition for the removal and prevention of incrustation in steam-boilers."—Hetition recorded February 13, 1873.

587. T. Cattell, M.D., Clarendon Square, Middlesex, "Improved methods for purifying gutta-percha."—Petition recorded February 17, 1873.

645. J. Webster, Birmingham, "Improvements in applying gases or vapour to the refining and purifying of metals, and in apparatus to be employed for that purpose."—Petition recorded February 20, 1873.

667. M. Henry, Fleet Street, London, "Improvements in the manufacture of sugar."—A communication from L. A. A. de Savignon, Boulevart Saint-Martin, Paris.—Petition recorded February 21, 1873.

672. F. Deakin, Willenhall, Staffordshire, "Improvements in puddling furnaces used in the manufacture of iron and steel."

680. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of sulphate of soda and sulphate of potassa."

682. A. M. Clark, Chancery Lane, Middlesex, "Improvements in the purification of syrups and sugar."—A communication from L. J. F. Margueritte, Paris.—Petitions recorded February 22, 1873.

695. J. A. Lee, Lydney, Gloucestershire, "Improvements in boiling wood or other fibrous material for the manufacture of paper, and in the treatment of the waste leys."—Petition recorded February 24, 1873.

701. J. Liebert, Kensington Park, Middlesex, "An improved mixture of ground substances to be used as a substitute for coffee, and in the apparatus employed in the preparation thereof."

704. T. Chappell, Finsbury Park, Middlesex, "Improvements in the manufacture of gas."

705. J. Fawcett, Kirton-in-Lindsey, Lincolnshire, "Improvements, in the treatment of peat."—Petitions recorded February 25, 1873.

710. E. Metge and F. N. C. Vinbert, Boulogne-sur-Mer, France, "An improved mode or process of preserving meat."—Petition recorded February 26, 1873.

728. A. E. Webb, Stepney, Middlesex, "Improvements in candles and night-lights, and in the treatment of materials therefor."

732. J. G. Redman, New Brompton, Kent, "Improvements in compositions for preventing the corrosion and the fouling of ships' bottoms or other submerged structures."

736. R. Jukes, Sheffield, "Certain improvements in the construction of reverberating furnaces or cupolas, and in the processes connected therewith for the purpose of smelting."—Petitions recorded February 27, 1873.

NOTICES TO PROCEED.

3101. W. R. Lake, Southampton Buildings, London, "Improved processes and apparatus for manufacturing compounds of pyroxyline or gun-cotton."—A communication from J. W. Hyatt and J. S. Hyatt, Albany, New York, U.S.A.—Petition recorded October 21, 1872.

3198. J. Foley, Montreal, Canada, "Improvements in the manufacture of half-stuff and paper."—Petition recorded October 28, 1872.

1. C. W. Harrison, High Holborn, Middlesex, "Improvements in treating certain gases for lighting and heating purposes, and in combining atmospheric air therewith."—Petition recorded January 6, 1873.

305. H. Deacon, Widnes, Lancashire, "Improvements in the manufacture of chlorine."—Petition recorded February 11, 1873.

599. C. W. Sutton, Stowmarket, Suffolk, "Improved combinations of ingredients for removing acidity from ales, beers, porters, wines, &c., and also to preserve them from acidity."—Petition recorded February 18, 1873.

PATENTS SEALED.

2648. A. C. Duncan and A. Duncan, Manchester, "Improvements in the production of Turkey-red."—Dated September 6, 1872.

2667. E. Ross, Jeffrey's Square, London, "An improved method of utilising and giving additional value to the products of the coffee-bush."—A communication from R. Dawson, Colombo, Ceylon.—Dated September 9, 1872.

2687. B. B. Standen, Blackheath, Kent, "Improvements in collecting and treating human excrement, both solid and liquid, and in the treatment of other animal urine, also in the means or apparatus employed therein."—Dated September 11, 1872.

2719. W. R. Lake, Southampton Buildings, London, "An improved process and compound for tempering and refining steel."—A communication from W. N. Severance, South Bend, Indiana, U.S.A.—Dated September 13, 1872.

2943. E. J. Payne, Packwood, Warwickshire, and W. Clarke, Dudley, Worcestershire, "Improvements in converting or partially converting iron into steel."—Dated October 25, 1872.

3180. A. Malam, Dumfries, N.B., "Improvements in the manufacture of illuminating-gas, and in apparatus therefor."—Dated October 26, 1872.

3930. B. White and P. T. Hendry, Glasgow, N.B., "Improvements in treating liquids to be burned for illuminating purposes."—A communication from J. Hale, jun., Cincinnati, U.S.A.—Dated December 27, 1872.

3956. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of maize and other like grain for the production of starch therefrom, and in the utilisation of the waste-products for the manufacture of cardboard and paper and for the preparation of soaps."—A communication from E. Leconte, Paris.—Dated December 30, 1872.

14. G. Rawle and W. N. Evans, Bristol, "Improvements in the manufacture of leather."—Dated January 1, 1873.

35. W. B. Stephens, Strand, Westminster, "Improvements in the manufacture of paints."—Dated January 3, 1873.

168. J. L. F. Target, Portsdown Road, Middlesex, "Improvements in treating excreta and sewage matters, and in apparatus employed therein, parts of the apparatus being also applicable to the drying and charring of other matters."—Dated January 15, 1873.

216. L. Stevens, Washington, U.S.A., "A process for forming carbonic oxide from oxyhydrogen vapour or steam, and an apparatus for utilising the same for heating purposes."—Dated January 18, 1873.

NOTES AND QUERIES.

Ponceau.—In the CHEMICAL NEWS, vol. xxvii., p. 20, ponceau made from carbolic acid is mentioned. Do any of your readers know where we can find a description of this ponceau, and its mode of manufacture. —S. and H.

Bunsen's Burner.—Can you tell me if there is any mathematical formula for increasing the size of Bunsen's burner. I want a large one, say two inches diameter, to burn with a steady flame. I can succeed very well with a tube half an inch diameter, and five inches long, but that is too small.—E. R.

Ammonium Sulphate.—Can you, through your valuable paper, or otherwise, inform me how ammonium sulphate in concentrated solution is usually concentrated so as to "fish" out the anhydrous salt. Are lead or iron vessels used, or lead supported by iron; and is a steam or fire heat used? My steam won't do it applied at two and a half atmospheres. It seems to me as if it would soon destroy a jacketted *wrought* iron pan, as it becomes strongly acid when boiled long. The quantity I have to operate upon is large, say 1000 gals. at a time. I have consulted your Wagner's "Technology," and Richardson and Watts without finding what I want. Any information will oblige.—W. B. GILES.

On Approach Caused by Vibration.—Dr. F. Guthrie, in a paper read before the Royal Society, December 17th, 1868, says:—"There is, perhaps, nothing essentially contrary to reason in the conception of two bodies in space free to move so related to one another that, while the first has no tendency to move towards the second, the second has a tendency to move towards the first. But if the tendency of the one to move be caused by the condition of the medium between the two, it seems inevitable that the tendency shall be mutual. Thus, if that tendency result from a general diminution in the tension of an elastic medium between the two, they will be urged towards one another." . . . . "We have here, accordingly, an experimental proof that the rapid motion (in this instance vibration) of a body in a medium produces, on the whole, an effect similar to that which would be produced by the expansion of the body, viz., a displacement of the medium." . . . . "Whenever an elastic medium is between two vibrating bodies, or between a vibrating body and one at rest, and when the vibrations are dispersed in consequence of their impact on one or both of the bodies, the bodies will be urged together. . . . The line of conclusion here indicated tends to argue that there is no such thing as attraction in the sense of a pulling force, and that two utterly isolated bodies cannot influence one another." . . . . "If the ætherial vibrations which are supposed to constitute radiant heat resemble the aërial vibrations which constitute radiant sound, the heat which all bodies possess, and which they are all supposed to radiate in exchange, will cause all bodies to be urged towards one another."

MEETINGS FOR THE WEEK.

MONDAY, March 24th.—Medical, 8.
—— Royal Geographical, 8½.
—— London Institution, 4.
TUESDAY, 25th.—Civil Engineers, 8.
—— Royal Institution, 3. Prof. Rutherford, "On Forces and Motions of the Body."
WEDNESDAY, 26th.—Society of Arts, 8.
—— Geological, 8.
THURSDAY, 27th.—Royal, 8½.
—— Royal Institution, 3. A. Vernon Harcourt, M.A., F.R.S., "On the Chemistry of Coal and its Products."
—— Philosophical Club, 6.
FRIDAY, 28th.—Royal Institution, 9. Prof. W. K. Clifford, "On the Meaning of Force and Energy."
—— Quekett Microscopical Club, 8.
SATURDAY, 29th.—Royal Institution, 3. Prof. Max Muller, LL.D., "On Darwin's Philosophy of Language."

TO CORRESPONDENTS.

T. R.—You will find full information on rendering paper sensitive to electric currents in vol. xxvi., pp. 60 and 155.

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THE CHEMICAL NEWS.

Vol. XXVII. No. 696.

ON SUPERSATURATED SALINE SOLUTIONS.*

By CHARLES TOMLINSON, F.R.S.

This subject, which has been discussed during nearly three-quarters of a century, and has occupied many subtle minds, cannot be said to be at present in a settled condition. Some observers, even at the present day, imagine that any one of these solutions is a liquid in a state of unstable equilibrium ready, on slight provocation, to pass into the solid form. A recent writer remarks that these solutions can be preserved a long time, provided the vessels containing them be kept quite still. One observer found that on introducing a knitting-needle into the solution it produced crystallisation, but when passed through the cork which closed the flask it had no such effect. In cases of this kind the distinction, first pointed out by Mr. Tomlinson, between chemically clean and unclean surfaces, or, as he calls them, *catharised* and *uncatharised*, clears away a host of anomalous cases, and reduces the problem to the simple question—"What is a nucleus?" He has shown that bodies by exposure to the air, or to the touch, become more or less covered with films foreign to their composition, and which make them unclean, so that, if introduced into a supersaturated gaseous, vapourous, or saline solution, they liberate gas or vapour, or determine crystallisation. So, also, an oil or other body, deposited on the surface of the solution so as to form a film, determines crystallisation; whereas, if such body retain the lenticular or globular form, it does not induce crystallisation, since it is separated from the solution by surface-tension.

On the other hand, it is maintained by several observers, among whom we may distinguish M. Gernez and M. Violette, (1) that the only nucleus capable of suddenly crystallising any one of such solutions is a salt of the same kind as that dissolved; and (2) that all bodies, solid, liquid, or aëriform, which apparently act as nuclei, are really contaminated with a hydrate of the salt that forms the supersaturated solution.

In dealing with supersaturated solutions, we may take that of sodic sulphate as a type. It will be remembered that this salt exists in three forms—(1) The ordinary salt, containing ten equivalents of water of crystallisation. By exposing this salt to the air it passes rapidly into (2) the effloresced or anhydrous salt. There is (3) a seven-hydrated salt formed in supersaturated solutions, in close vessels, on a suitable reduction of temperature.

Now everyone admits that of these three varieties the ten-atom hydrate is the only one that acts as a nucleus on a supersaturated solution of Glauber's salt, and that the seven-atom hydrate and the anhydrous salt have no action whatever as nuclei.

Of course, if it can be shown that an oil or other body does, under certain conditions, induce the crystallisation of a supersaturated solution of Glauber's salt, the theory, that a crystal of the ten-atom hydrate of sodic sulphate is the only nucleus, falls to the ground.

Without reiterating former experiments, about which there is so much controversy, Mr. Tomlinson falls back upon a statement made by him in his second paper, published in the *Philosophical Transactions* for 1871, to the effect that, if a drop of oil deposited on the surface of a supersaturated solution of Glauber's salt form a lens, there is no separation of salt, even though the flask be turned round rapidly so as to disperse the oil in small globules through the solution. But, "if while the flask is being turned round, a sudden jerk be given to it, so as to flatten some of the globules against the side into films, the whole solution instantly becomes solid."

In a note read before the Royal Society on the 13th inst., the following experiment was described:—

A solution of sodic sulphate (1 part of salt and 1 part of water) was filtered into a pear-shaped flask nearly 12 inches in height; a small beaker was put over the opening in the neck, and the solution boiled. Next day the flask was taken into the open air, oil of sweet almonds was dropped into it, and the cork inserted. After about an hour the flask was whirled round, so as to disperse the oil into minute globules through the solution, giving it the appearance of an emulsion. The flask was left at rest during about an hour, then suddenly shaken, so as to rattle the solution against the side, when all at once, as if with a flash, it became solid.

Now in this case it may be objected that a crystal of the sodic sulphate hydrate was derived from one of the following sources:—(1) From the air, (2) from the oil, (3) from the cork, or (4) from the side of the flask. (1). It could not be derived from the air, either of the laboratory or of the open air, because the solution remained liquid long after the flask had been corked. (2). It could not have been derived from the oil, because this was dispersed through the solution in myriads of globules without any nuclear action, and the flask was left to repose for an hour after the oil had been so dispersed. (3). Nor could any nucleus have been derived from the cork, because the solution never touched it. Nor could a minute speck of the sodic sulphate hydrate have fallen from the cork, for the latter had been put into hot water, out of which it was taken the moment it was put into the flask. It could not have been derived from any of the hot water from the cork streaming down the side of the flask to the solution, (1) because sodic sulphate in solution is in the non-nuclear anhydrous state, and (2) because two hours had elapsed between the corking of the flask and the solidification of the solution. (4). A crystal could not have been derived from the walls of the flask, because the solution had been briskly boiled in it, so that steam escaped with considerable force from the neck after the small beaker had been put on. Hence, on the principle of exhaustion, Mr. Tomlinson is compelled to fall back on his former statement—namely, that the oil acted as a nucleus by the flattening of one or more of the globules against the wall of the flask into the form of films.

A number of experiments were tried with solutions of various strengths—such as 2 salt to 1 water, 3 salt to 1 water, 3 salt to 1½ water; and also with other salts, such as potash-alum and ammonia-alum; and with various oils, volatile and fixed—the object being to show that some supersaturated saline solutions really do crystallise under the action of other nuclei than a salt of the same kind as the solution operated on.

All the experiments were conducted in the open air, although they were much impeded by the rainy weather of last year. There is, however, this advantage in wet weather, that the saline particles said to exist in the air are washed down and brought into solution, in which condition they are not nuclear, as has been shown in the case of sodic sulphate, alum, and one or two other salts.* On the other hand, fine weather has its advantages; not only are the surfaces of the solutions more active, and the evaporative force stronger, but hydrated salts, said to exist in the air, part with their water of crystallisation so readily as to reduce them to the non-nuclear condition, while the minute particles of the salt, said to give force to the dust floating in a room, could not exist in the hydrated form for an hour. This is especially the case with sodic sulphate. It had been already shown that supersaturated solutions of this salt may be exposed to the air, both in fine and wet weather, for a long time without crystallising,† as well as the the fact just noticed,‡

* Abstract of a paper read before the Royal Society.

* Chemical News, February 4, 1870, p. 52.

† *Proc. Roy. Soc.*, 1871, p. 41.

‡ Chemical News, February 4, 1870, p. 52.

that a solution of a salt does not act as a nucleus to its supersaturated solution.

Seeing, then, that in the case of sodic sulphate, which is said to be always present in the air of rooms, and, according to MM. Gernez and Violette, even in that of the country, the chances are that it is most likely to be present either in the effloresced condition or in solution, and equally non-nuclear in both, Mr. Tomlinson thinks that too much importance has been given to this part of the subject; for, if it be true, we are reduced to the dilemma, pointed out by M. Jeannel,* that there must be floating in the air specimens of all kinds of salts that form supersaturated solutions and crystallise by the introduction of a solid nucleus; whereas, there are some such salts which cannot exist in the presence of the oxygen or of the ammonia of the air.

INFLUENCE OF CHANGES IN BAROMETRIC PRESSURE ON ANIMAL LIFE.

We propose to follow the progress of M. P. Bert's researches on this subject, as recently described to the Paris Academy of Sciences.

In the series of experiments, of which an outline has already been given in the Chemical News (vol. xxvi., pp. 38 and 136), the principal points taken up by M. Bert have been these;—Effects of diminished pressure, with special reference to composition of enclosed air after death of the animal; effects of increase of pressure similarly; effects of super-oxygenated air at increased and at diminished pressures; quantities and proportions of gases in the blood of animals subjected to diminished pressure of ordinary air; the same in case of increased pressure; effects of decompression, gradual and sudden.

One of the most singular facts met with in these researches was the undoubtedly toxical action of oxygen in air sufficiently compressed. To this phenomenon M. Bert has given further attention.

In sparrows this action is shown by strong convulsions, when the exterior pressure of oxygen may be represented by 350 (the pressure of pure oxygen at 1 atmosphere being taken as 100), which may be obtained either by using pure oxygen at $3\frac{1}{2}$ atmospheres ($100 \times 3{\cdot}5 = 350$), or ordinary air at about 17 atmospheres ($17 \times 20{\cdot}9 = 355$). These convulsions are very violent, and quickly fatal when the pressure of oxygen reaches 450 (corresponding to 22 atmospheres of air). They appear in about 4 or 5 minutes; the bird shakes its head and feet as if it were on burning coals; presently it opens out its wings, which flutter violently; then falling on its back, it turns about quickly in the receiver, continuing to beat the air with its wings, and its feet being drawn in. These movements continue a few minutes, then are stilled; reappearing, however, and repeatedly, in crises, which become more frequent and less violent, till death or release. They may, however, continue after the air has been restored to normal pressure.

With dogs, also, M. Bert found convulsions appear when the external pressure of oxygen was about 350, while death took place at a pressure of about 500. As he had not sufficient oxygen to charge his receiver (of 400 litres' capacity) to 5 or 6 atmospheres, he took the plan of fixing in the trachea of a dog a pipe connected with a caoutchouc pouch which contained oxygen, and subjected pouch and animal to pressure at the same time. Extracting arterial blood, and determining the proportions of gases in it (in a way previously described), he found the convulsions appear when this blood, which ordinarily contains 18 to 20 c.c. of oxygen per 100 centimetres of liquid, came to contain 28 to 30 c.c., in consequence of pressure. Death took place at about 35 c.c. It thus appears that the toxically fatal proportion of oxygen in the blood is less than double the normal quantity. There is no other poison of which we could, with impunity, have in the blood half of the dose which would prove fatal.

M. Bert describes the phenomena presented by a dog in which the proportion of oxygen in the arterial blood has attained 32 c.c. per cent. When taken from the aparatus the animal is generally in full tonic convulsions; the paws are rigid; the body is curved backwards or a little to one side; the eyes are protruded, the pupils dilated, the jaws closely shut. There are, as in the case of sparrows, relaxations and recurring crises; in the latter, respiration is suspended, but the heart continues to beat, though often very slowly; sensibility remains. The convulsions become less violent; the rigidity diminishes, and finally disappears at the end of five, ten, or even sometimes twenty hours.

In the lighter cases, there are disorderly movements and local convulsions, the phenomena generally resembling those produced by phenic acid. In the more severe, on the other hand, as when the proportion of oxygen reaches 35 c.c., the rigidity is more continued, with occasional clonic spasms; the teeth are ground together, and death appears after one or two crises, in a few minutes. The arterial blood is dark, as in asphyxia; the heart continues to beat some minutes after the animal has ceased to show any other movement.

As to the mechanism of the poisoning, M. Bert infers from his experiments that the toxical action produces its effect on the nervous centres like strychnine, phenic acid, and other such convulsive poisons. This presumption is corroborated by the fact that the inhalation of chloroform momentarily arrests the convulsions, which reappear when the anæsthesia has ceased. A posterior limb, the sciatic nerve of which has been cut, shows no convulsions in the muscles connected with this nerve.

It is a striking fact, that the convulsions often continue after the blood, through free respiration, contains no more than its normal quantity of oxygen. May it happen that, under the influence of oxygen, there is formed in the blood a toxical matter capable of altering the functions of the anatomical nervous elements? M. Bert thinks not; he injected into the veins of a healthy dog some blood taken from an animal in full convulsions produced by oxygen, and no toxical effect was observed. The blood corpuscles, moreover, show no particular alteration in form or dimensions.

The temperature of the animals fell two or three degrees when the convulsive action commenced, and rose again at the end of a few hours if the animal survived. The increased oxygen is not, then (as might be thought), the occasion of more energetic combustion; on the contrary, the internal combustion seems to be diminished. This apparently paradoxical conclusion M. Bert proposes further to investigate.

The results of this enquiry, then, are briefly these:—Oxygen, a powerful poison when its proportion in the arterial blood reaches about 35 c.c. per 100 c.c. of the liquid; the poisoning characterised by various convulsions, which are due to increased excito-motor power of the spinal cord; and the process attended by diminution of internal temperature.

In studying the dangerous and fatal effects of sudden decompression, M. Bert had attributed them to the return of nitrogen, dissolved in excess in the blood, to the free state. The gas-bubbles may only intercept the circulation in particular parts, and especially in the lumbar region of the spinal cord, whence ensues paraplegia, &c.; but they may appear in sufficient quantity to obstruct the lungs, inflate and arrest the heart, and cause speedy death.

Now, it appears that the danger is very various for different species and different individuals. Thus for sparrows, death (from sudden decompression) appears only when the pressure has reached 11 atmospheres; for rabbits and cats, the limit is about 9 atmospheres; for dogs, it oscillates between 7 and 8. It would seem that the danger increases with the animal's size; and we know

* *Ann. d. Chem. et de Phys.*, 4th ser., vol. vi., p. 166.

that in the case of man there are fatal accidents at 5 atmospheres.

Applying himself to these curious inequalities, M. Bert ascertained, first of all, that the arterial blood of a dog which breathes air at normal pressure is nearly saturated with nitrogen at the same pressure. He watched the blood in dogs submitted to increasing pressures, and saw gas-bubbles first appear at about 3 atmospheres. But the injurious effects did not appear till about 7 atmospheres. There is, then, between 3 and 7 atmospheres, a period in which the blood of decompressed dogs may contain free gases, without the animals appearing to suffer. This is doubtless because the bubbles are so fine that they can pass through the capillaries without causing obstruction. Still it is to be remembered that there is danger in this period, and certain accidents may occur even in decompression from low pressures. This is evident from the fact that some divers, *e. g.*, are paralysed, and sometimes killed, through decompression, which produces no injury to others. In the period referred to the bubbles have only to collect in a particular manner, under secondary causes, in order to cause serious accident.

As M. Bert was pursuing his inquiries, an accident occurred to interrupt his work, but which, at the same time, brought to light a fresh fact connected with the subject.

He had been keeping a dog under a pressure of 9½ atmospheres for about an hour, when one of the glass plates in the side of the chamber broke with a loud explosion, and the apparatus was torn from its supports by the violent recoil. The animal, of course, was instantly killed, and its blood-vessels were found, as usual, to be filled with gas; but for the first time M. Bert found gases in the ventral cavity, with a general emphysema of the subcutaneous and intra-muscular cellular tissue. Thus it appears that the liberated gases may accumulate not merely in the blood, but in the other juices of the system. The reason they were not here met with before was, probably, that the decompression had not been sufficiently sudden, or that the animals had not remained long enough under pressure. The itching and muscular swellings often experienced by workmen in tubes may probably be connected with a fine gaseous infiltration of the cellular tissue.

How are accidents through decompression to be prevented? Obviously (it is replied) by a prudent and measured decompression. When a pressure of 9 or 10 atmospheres has been reached, it is necessary the decompression should not be faster than 12 minutes per atmosphere. It sometimes appeared advantageous not to decompress regularly, but to proceed by sudden falls of 1 to 2 atmospheres, allowing the animal a certain time of equilibrium after each fall.

When injury has been done, when paralysis *e.g.* has commenced, when death is imminent, is it possible to remove the danger, and how? The first idea which occurred was to recompress the animal, in order to re-dissolve the liberated gas; it would then be sufficient to decompress more prudently. M. Bert's apparatus, however, did not permit of his effecting this. An hour was consumed in increasing the pressure to 10 atmospheres, and the animal was by that time dead. He thinks, however, the method may be employed in the case of divers, who should immediately be sent down into the water again.

How is death in the above cases produced? The bubbles of nitrogen accumulate in the right side of the heart and in the pulmonary arteries. They remain there; without becoming dissolved, because the blood is saturated with nitrogen; without being diffused, because the air of the alveoli contains four-fifths of nitrogen. M. Bert hoped, however, by making the animal respire a gas not containing nitrogen, that the diffusion would proceed quickly enough to allow of a renewal of the pulmonary circulation, and so, of the animal being relieved. In this he succeeded. He made dogs which were completely paralysed, whose hearts gave a gurgling sound, and whose jugular veins, laid bare, appeared inflated by the gas, breathe oxygen nearly pure: the gas-bubbles in the jugular rapidly disappeared, the sounds of the heart became normal, and the respiration regular.

In some cases, however, paraplegia or paralysis continued several hours, and the autopsy explained this. In the general circulatory system the liberated gas had disappeared, but in the nervous centres there were small vessels filled with gas-bubbles, so that the local circulation in these important organs was arrested.

From the foregoing results M. Bert finds himself in a position to advise engineers and others, who employ divers and workmen exposed to the dangers in question, to make their men respire oxygen after decompression, where this is apt to be dangerous. They might afterwards try recompression; but the respiration of oxygen forms a remedy at once simple, inexpensive, easy of application, and perfectly harmless.

A. B. M.

ON THE

INORGANIC CONSTITUENTS OF SOUND AND DISEASED POTATOES.*

By J. B. HANNAY, F.C.S.

As great discrepancy of opinion exists as to the cause of the potato disease, I thought it might be of some interest to carefully analyse an average sample of both good and bad roots from the same field, especially as some chemists say that a deficiency of potash, and some that an excess, is the cause of the disease.

I obtained three samples—the first consisting of good potatoes grown on well-drained, dark-coloured, mossy soil; the second from the same field were very much diseased, and quite unfit, not only for human food, but were even rejected for cattle-feeding purposes; the third sample was from a field which was badly drained and of a heavy clayey nature. The three samples had received the same manure. The whole of the third sample was diseased, but of an intermediate degree; they could mostly be used for human food, but there was not one which was not in some degree diseased. The following are the results of the analyses:—Sample No. 1, when cut in slices and dried, left 3·8 per cent of ash, No. 2 left 3·9 per cent, whereas No. 3 left 5·1 per cent.

	No. 1.	No. 2.	No. 3.
Soluble portion—			
Potassium	36·77	37·86	43·11
Sodium	3·24	3·12	0·68
Magnesium	1·87	0·00	0·04
Carbon dioxide	15·83	15·57	15·45
Phosphoric oxide	8·37	6·90	5·55
Sulphuric oxide	4·95	5·44	6·28
Chlorine	4·61	6·96	7·37
Insoluble portion—			
Silica	1·74	6·12	1·02
Ferric oxide and alumina	0·62	0·89	1·17
Calcium	3·70	2·80	2·92
Magnesium	0·88	0·60	0·02
Carbon dioxide	2·90	1·45	1·34
Phosphoric oxide	3·70	3·06	6·20
Unburnt carbon	1·98	0·00	0·00
Oxygen, equivalent to metals *minus* equivalent proportion of chlorine	0·64	0·03	0·23
	100·80	99·30	100·38

From these analyses it will be seen that the amount of potassium chlorine and sulphuric acid increase in the diseased root, whereas the soluble phosphoric acid decreases.

* A paper read before the Chemical Section of the Glasgow Philosophical Society.

I noticed on burning the potatoes that in good roots it was very difficult to oxidise all the carbon, in fact the ash obtained was always of a very dark gray colour. In diseased potatoes, however, it is comparatively easy to burn all the carbon, leaving the ash of a greyish white colour. This seems to show that in good potatoes the mineral constituents are more intimately combined with the carbon compounds than in diseased roots, or, in other words, that the disease seems to be a constitutional decay. There is a great deal of evidence in support of this view, and, moreover, most of the practical farmers with whom I have conferred on this subject are of opinion that it is similar in nature to fever or any infectious disease which infect animals. They have found that fields of potatoes growing perfectly healthy have, in the course of a single day, been infected with disease by a mere change of wind, and almost invariably when that change is to the east; even a hot sultry day will sometimes bring on the disease. It always appears on the leaves first, and the roots sometimes show no signs of disease for three weeks after the leaves are infected. On examining a number of specimens by the microscope, I find that on the appearance of disease the starch granules gradually diminish in size and number till, in the very badly diseased parts, only a confused mass of fibre remains. In the good potatoes the starch granules were very full and well developed, whereas in the diseased roots they were very small and meagre. This also points to a constitutional decay.

Most farmers tell me that potatoes grown in dark mossy soil are much less liable to disease than those grown in a clay soil, and, even when the mossy soil is wet and not drained, the roots grown there are almost invariably better than in a clay soil. This seems to show that the average temperature of the soil in which the roots grow has a good deal to do with the health of the plant, as it has been found that the darker the colour of the soil the higher is the average annual temperature.

It may be worthy of remark that some farmers strongly recommend the use of soot as a prevention of disease; and, as the chief property of soot is to absorb all the sun's radiant heat, while it is the only substance which diffuses or reflects none, this affords a further argument in support of the idea that heat applied to the root strengthens the plant. The disease seems to be to the potato what fever or cholera is to man, and is caused by the same conditions —namely, an east wind and sultry weather. The difference in the mineral constituents seems to have little connection with the disease, but there can be little doubt that proper manure and good soil may strengthen a plant, so that, when the withering winds do come, it will be able to withstand the attack of disease. The mineral constituents seem to vary with the soil and locality; in fact, one farmer, who had a field running down to the sea-shore, informed me that the potatoes close to the shore had a large proportion of their potash replaced by soda. On the whole, I think the potato disease is a problem for the naturalist or the physiologist rather than the chemist.

NEW THEORY OF GALVANISM.*

This is a remarkable book. In proof we quote some short sentences from the preface:—"In this perhaps presumptuous effort heat is viewed in entirely novel aspects. Heat is considered no longer exclusively a thing of thermometers and pyrometers, but as a great power in chemistry."

We were certainly of opinion that this had been acknowledged long ago—ever since the science of chemistry existed. Again,—"Heat is considered to be as closely kin to electricity as is infancy to manhood, and thus to be all-worthy of scientific apotheosis." Heat and electricity are generally considered to be merely modifications of force, and as such mutually convertible. The author, if we do not misunderstand him, views them as substantive entities. He informs us that "the most prominent heat-states of chemicals" are their "conditional heat, their specific heat, their weight-heat, and their conduction of heat." The "conditional heat," or "heatfulness," is that in virtue of whose varying degree hydrogen is an unliquefied gas, mercury a liquid metal, potassium an easily fusible metal, and platinum a well-nigh infusible solid. Hydrogen is, therefore, pronounced more "thermic" or heatful than platinum. Specific heat is defined in the usual manner. "Weight-heat, mass-heat, or grain-heat" is that which influences specific gravity, it being assumed "as axiomatic that the lighter a metal the better grained it is."

The allotropic forms of bodies, their "heat shapes," or "glow shapes," are due to different amounts of chemical heat. "To mixture and allotropy of ingredients we owe every chemical compound; mixture brought about by mutual mechanical attraction of the molecules of the combining substances; allotropy produced by the conditional heat-discharges, by loss or gain of heat of the said molecules."

We are again told that in "compounds where there is more mixture than allotropy of ingredients, as in alloys, the resulting compounds are like their parent metals." The generalisation is then suggested that the more violent the reaction which ensues on the contact of the elementary bodies, the more the resulting compound will be unlike either of them. "Heat of transformation, or morphigenic heat" is the great producer of changes. Metals very thermic, as potassium, are never found uncombined. Platinum, eminently athermic, is rarely found combined, and "has the strongest inclination to attract heat, as seen in Dobereiner's lamp." "By the test of weight the metals are, as a class, colder-grained than the metal-attracting metalloids; the metals are *minus* as to heat, and the metalloids *plus* as to heat."

The group of "metal-repellant metalloids"—carbon, silica, and borax—are "conditionally cold;" carbon being the coldest element known, as it has never been fused. Acids are thermic, bases athermic.

Heat influences solubility, so that a "soluble substance is more thermic conditionally than an insoluble one." The following remark is not without interest:—"It may be noted that the colours red and green, given by acids and alkalies to certain vegetable colours, are the acid red colour, the hot colour of the solar spectrum, and the alkali green colour, the cold colour of the solar spectrum." How about the aniline colours when these changes are nearly reversed? The elements are divided into three classes—"Those that have great chemical might, or power, or craft, or better still, shapecraft, such as the four organogens; those that have great chemical activity, such as potassium, sodium, &c.; and the elements that are truly negative, having neither shapecraft nor activity, such as platinum and gold."

The author's examination of the galvanic battery leads him to the conclusion that "ordinary heat, morphigenic heat, and electricity are phases of the same radicle principle." It becomes electricity by concentration.

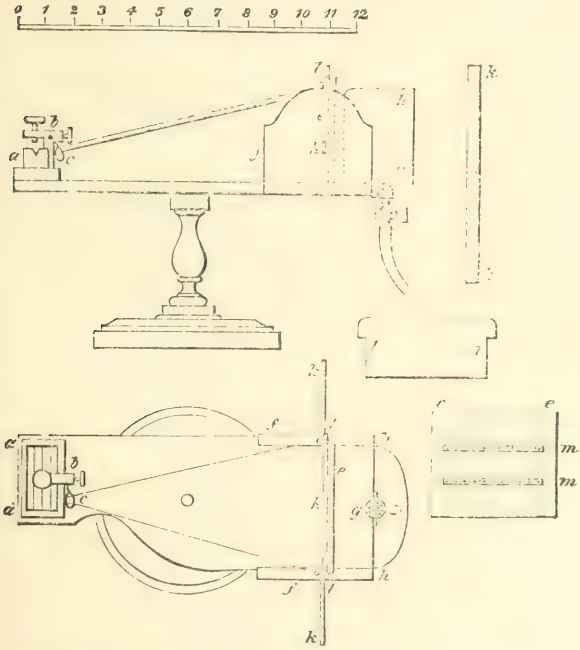
We have thus, as far as space would permit, endeavoured to give our readers some idea of the line of speculation followed in this decidedly original work. That many of the views put forward are questionable will be seen by every chemist. But instead of entering upon a lengthy verbal discussion, we prefer to remind the author of the fine dictum of Dumas:—"Theories are like crutches; to know their worth we must try to walk with them." If Dr. Hall can by means of his hypotheses succeed in bringing facts hitherto isolated into co-ordination—if he can point the road to phenomena as yet undetected, he will succeed in legitimatising his system. Meanwhile, we consider the book decidedly suggestive, and recommend it to the thoughtful perusal of chemists.

* "New Theory of Galvanism; the Electro-Thermology of Chemistry; Electricity and Heat Phases of the same Principle." By T. W. Hall, M.D., &c. Edinburgh: Edmonston and Douglas.

GLASS READING-SCALE FOR DIRECT VISION SPECTROSCOPES.*

By H. R. PROCTER.

MAHOGANY frame, of ¼-in. planed boards, for holding Browning's direct vision pocket spectroscope and reading-scale. *a a*, wood block with V-groove for holding the spectroscope; *b b*, brass clamp and screws for fixing it in its position, and for holding the wire ring, *c c*, to stretch the wire supports, *d d*, of a black curtain for keeping out stray light from the side-hole of the spectroscope; *e e*, photographed glass millimetre, or other scale of equal parts, sliding between two upright mahogany cheeks, *f f*, and lighted from behind by the gas-jet, *g g*; *h h*, a tin screen to shade the flame; *e e*, the dark-glass scale with transparent graduations at *m m*, seen in the spectroscope above and below the spectrum; the upper one can be shut off by a black card screen, *l l*, slipped down in front of the glass plate; and all but three scale-divisions of the lower one, at any point, can be stopped out by a card slider, *k k*, slipping through slits in the two side-cheeks of the frame, to confine the vision to the graduations closest to any



line. The glass plate is backed behind by a piece of oiled paper gummed by its edges to the photographic plate.

Mr. Procter apologised for bringing such a rough affair before the meeting; it was a purely experimental apparatus, but all he could say was that it had answered the purpose well, and he had not had time to get a better one made. No doubt every one who had used the small spectroscope had felt the want of some measuring apparatus, and he supposed that most members would know the construction of the instrument. It contained a compound prism, of which the end formed an angle of nearly 45 degrees with the axis of the tube. Consequently, by drilling a small hole in the tube opposite the face of the prism, you could see a scale set at right angles to it at the same time as by reflection you saw the spectrum. That was the whole principle of this apparatus. A small scale of any description, say of millimetres photographed upon glass, was set up on one side of the spectroscope and lighted by a gas jet. He might say he had found it a great assistance sometimes to cover all the scale, except the few lines which were required at the time, by a piece of card-board with a small slit in it. By sliding this through a hole in the instrument it covered the whole of the scale except two or three divisions, and by that means the dazzling effect of the remainder of the scale upon the eye was entirely avoided. By sliding it along, the centre of the slit was made to coincide with the line it was wished to measure, while the upper part of the scale was covered by a piece of card. Then by removing the card so as to see the upper part of the scale, it was instantly determined what the division was; and he thought that would be found a great practical advantage where the lines were faint. He had used the same measuring arrangement simply by putting the spectroscope in a retort stand-clamp, with this small hole pointing downwards to any sort of scale upon the table; even a foot rule lying on a piece of black velvet answered tolerably well. If the spectroscope was always set at a uniform number of scale divisions distant from the scale, the divisions would remain of the same value whatever their absolute size; and the only thing necessary to make comparative measurements at different times was to bring some one line always upon the same division, and the others perfectly corresponded. He thought it exceedingly probable that a much superior arrangement, so far as the details were concerned, could easily be made. A little care was necessary to get the spectroscope in the right position so as to make the lines come upon the scale. Mr. Browning had written to him to say that he would be very glad to pierce the spectroscopes for the purpose, without any additional charge.

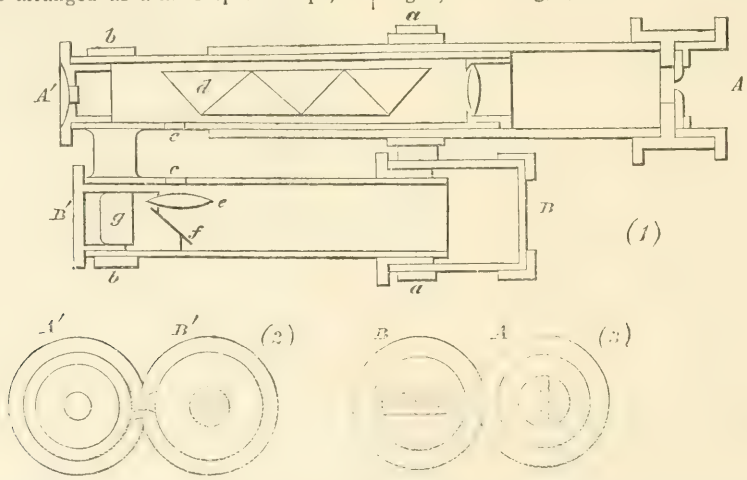
After the reading of this paper, Prof. HERSCHEL said the plan of throwing the scale into the side of the spectroscope was one which had struck him frequently during its use, as necessary for making it practically available. As a test of the identity of any substance which was studied through the spectroscope, some sort of scale is required with Browning's, as well as with every form of small pocket spectroscope. He found it practically, himself, in two or three cases recently. He was in the Elswick Works the other day, looking at the flame coming out from the blast, while stoking and taking the slag from the blast-furnace, and he saw a very brilliant red line. He was at a loss to name and identify that red line; he thought at first it was potash, but it was too sharp, indeed perfectly so. He was then persuaded from its character that it was lithium, but he was not then aware what the lithium could arise from. He asked the manager, who said a Greek ore was being used in the furnace, and that the red line might possibly be copper. He (Prof. Herschel) knew that copper gave a red line, and he put it down as copper as the result of the casual examination with the spectroscope. He was at Birtley Iron Works the other day, and the melting-furnace to melt the iron was blown with coke and a blast; and where the flame escaped it again presented that red line along with the soda—the two lines, yellow and red, which the members had seen that night in the demonstrations of Mr. Procter; but by this time he had made a provision in his spectroscope to make clear what this red line was, and he would be very glad to point out to them the character of that provision used in the spectroscope upon the table; and he was able then to identify the position of this red line after coming home, and to make clear that it was lithium. In most of these blast-furnaces lithium was most distinctly visible. He had only lately read, in books on spectroscopy, that in all gas-carbon and gas-coke lithium is always present, and is easily detected by the spectroscope in their flames; so that, although in the first of his experiments on the furnace-flame he was unable to use Browning's spectroscope as a means of analysis for which it is commonly found to be practically useful, yet, by adding to it a slide of a peculiar kind, he was able afterwards to make sure of the fact that there was lithium in the flame. He congratulated Mr. Procter

* Read before the Newcastle Chemical Society.

on his success in making this little Browning's spectroscope a really practically useful instrument; but while his adaptation and fixing of the scale to it, by which the position of the lines could be measured in the instrument, had done much, no one could carry this about with him, and it was therefore not a pocket scale. The small addition which he (Prof. Herschel) had made to that pocket spectroscope was to put a little film, the thinnest he possibly could, of mica on the glass plate which fitted the eye, and he held it in place with a small india-rubber ring. That film of mica, by inequalities of its thickness, or other refracting properties which it possesses, eclipses certain rays of particular refrangibility, and, according to the thickness, it will eclipse more or fewer bands in the whole range of the spectroscope; so that, looking through it, you get the spectroscope divided into compartments by dark bands. He found four lying between the yellow sodium line and the red one seen in the blast at Birtley; and after coming home, he found the same in looking at a flame of lithium and sodium together. The dark bands are, however, not easily observed. He did not say that his scale was a good one, but it was a pocket one, and it differed in that respect from Mr. Procter's. Then, as the bands are not easily seen, he thought he would bore a hole in the side of the spectroscope, and get a scale reflected in its prisms; and if this scale was to be a pocket one, he must, in this hole, which was bored through, put a small lens, and fix the scale close in front of that lens, for use as a scale of reference. In this form it would have been a miniature of what Mr. Procter had devised; but he could not say he had gone so far as Mr. Procter had to work out a practical result. It would certainly scarcely even in that form be convenient to fold up and carry about; but in the present form, in which it is arranged as a table spectroscope, it has certain very valuable advantages. The use of a spectroscope resolves itself into placing every line according to its scale position on any arbitrary scale, but as far as possible on the scale of what is called the natural standard scale of wave-lengths. If the position of every line which is mapped can be given in wave-length, its description is then intelligible to everybody. The scale fitted to this spectroscope, of uniform intervals, would enable spectra to be recognised; but being a new instrument its indications first require to be reduced to some well-known standard. The simplest way of recording them would be by wave-lengths. The positions of successive lines, as seen in the common spectroscope, are not in the simple proportions of their wave-lengths; the blue lines are more spread out than corresponds to the differences of their wave-lengths, and the red lines are nearer together, while the wave-lengths in the latter part of the spectrum are far apart; and therefore the question was how to pass from a uniform scale used in a spectroscope, in the manner shown by Mr. Procter, to the scale of wave-lengths. He had quite recently found that a uniform scale, used with any spectroscope, like that divided in Mr. Procter's instrument into millimetres, is approximately proportional to a scale of inverse fourth-powers of the wave-length. If, for example, we take the readings of the sodium line, and of any other known line of the spectrum, on a scale of equal parts, and replace them and all the other readings of the scale in proportion by the inverse fourth-powers of the wave-length, we would then find that we can pass from the uniform scale to the wave-length by taking the inverse (or reciprocal) of the readings so replaced, and taking the fourth-root of that reciprocal to obtain the wave-length. It so nearly was the case in all prisms of ordinary dispersion, as to present an almost accurate means of passing without trouble from the uniform scale of the spectroscope to the wave-lengths; and although it is not quite true of the whole range of the spectroscope, yet if used between the short interval of two neighbouring lines to find the wave-length of an intermediate line, it will give the wave-length of that line directly from the milimetre scale.

PROCTER'S DIRECT-VISION MICROMETER SCALE FOR POCKET SPECTROSCOPES.

A A', small direct-vision spectroscope. B B', a parallel brass tube (first slide of a miniature toy telescope) braced to the tube and draw-tube of the spectroscope by the double rings of bent copper plate, *a a*, *b b* (seen also in Fig. 2). The ring, *a*, slides on the main tube of the spectroscope by a collar of soft leather interposed between them. *c c*, small holes about one-eighth inch diameter drilled opposite to each other in the brass tubes for viewing a magnified image of the reading scale, B, reflected in the prism face, *d*. *e f*, a lens of short focus, and thin silvered glass diagonal mirror, cemented on a cork, *g*, in the stopped eye-end of the telescope tube, for obtaining a magnified view of the glass reading scale at B. The latter is marked in transparent lines on an opaque ground, as shown in Fig. 3, and is illuminated by the same direct light as that of which the spectrum is observed.



The Royal Hospital for Diseases of the Chest.—H.R.H. The Duke of Edinburgh will preside at the Fifty-ninth Anniversary Festival of this Hospital, to be held at the City Terminus Hotel, Cannon Street, on Monday, May 19th next.

FRESENIUS AND HIS LABORATORY.

By J. S. UNZICKER, M.D.

DR. R. FRESENIUS, although fifty-four years of age, is yet in his prime of life, as regards mental and physical activity. Being one of those few hard workers and original thinkers, he has accomplished much for science and mankind generally. Of his great reputation as a chemist I need not speak—that is well known to all men of science. But as a man also, no one stands higher in the community, nor more respected by all who know him, than he does, for his urbanity and universal kindness toward all who may come in contact with him.

It is not in chemistry alone that he has built up a great reputation, but he has also rendered great services in natural science, public education, agriculture, and manufacturing. All of which he has, and is still aiding by his extensive knowledge and labours. In acknowledgment of this, the Government has conferred upon him the title of "Privy Councillor of Court."

Laboratory.

This is a private institution assisted by the state, but owned and under the entire supervision of Dr. Fresenius. It is located on "Capell strasse" in Wiesbaden. The building is 120 feet front, overlooking the city, with a fine view of the Taunus mountains in the distance.

The laboratory includes three distinct departments:—

1. Qualitative analysis.
2. Quantitative analysis.
3. Manufacturing,

Students entering the institution commence work in the qualitative laboratory, which is a room 24 by 45 feet, well lighted, and accomodating thirty-three students. The room is furnished with a set of Bunsen's filtering pumps, glass blowers, lamps for fusions, and apparatus for keeping up a constant supply of distilled water. By means of large wooden hoods shut off from the laboratory by glass sashes, all noxious vapours are conducted off. Each student has his work table, also a closet with lock and key attached thereto. The course of work consists in the analysis of one hundred different substances of unknown composition. Fresenius visits his students daily, and always expects a detailed account of the work of each; and where a difficulty arises, lays great stress on the importance of every reaction being tried for itself. The quantitative analysis is conducted in a room 24 by 40 feet, having tables for nineteen students, and is fitted with all the necessary apparatus like the first. In this, as well as in the former room, two assistants representing Fresenius are constantly occupied. The quantitative assaying room, accommodating six students, is furnished with a cupel and assay furnaces, &c. HS, as a reagent, is employed only in the open air; for which purpose an apparatus yielding a constant supply and covered by a hood is convenient to each room. The balance-room, containing nine chemical balances, is situated between the two quantitative rooms, and is carefully heated to a constant temperature. The course of work in the quantitative department consists in the analysis of about fifty different minerals; alkalies, ores, paints, dye stuffs, coal, soap, and manure; fire assays and elementary analysis of sugar, starch, gum, gas analysis, &c. All quick and practical methods for purely technical purposes are here most thoroughly worked out, and students can fit themselves to become at once chemists in all branches of manufacture.

In the manufacturing department, the chemical reagents used in the Institution are made in a state of almost absolute purity by an experienced assistant of Fresenius. In the furnace-room you will find sand-baths and retorts for the purification of acids, &c. Here instruction is given in special branches of manufacture, as of aniline colours, crystallised salts, &c. The library-room contains a complete selection of all standard works and journals relating to chemistry and all branches connected therewith, where students can retire for consultation. The store-room contains a complete selection of chemical apparatus, where students can supply themselves at low rates. There are also two lecture-rooms; a private test-room, with analytical balances and other apparatus, to prove the correctness of important analysis. Next comes the private laboratory, library, study, and reception rooms of Fresenius. The best students, after completing their studies, are generally allowed to become private assistants to Fresenius in his own laboratory. These positions are much sought after, yielding no pay, but affording the greatest opportunities for more perfect and practical experience. Students have to provide themselves with all the small utensils and apparatus necessary, but all large ones are loaned to them by the Institution. The pharmaceutical department connected with the Institution is also assisted by the State. The summer semester (course) begins April 24th, and continues four months. The winter semester begins October 15th, and continues four and a half months. The charges are very moderate, being only, for a full laboratory course of one semester, £7 7s. It is, however, optional with students to work as many days in the laboratory as they please, for which proper deduction is made. This arrangement or declaration must be made at the beginning of the session.

The honorary fees for the lectures of the Institution are as follows:—

	£	s.	d.
Experimental chemistry, first division ..	1	5	6
,, ,, second division ..	1	5	6
Organic chemistry	1	5	6
Special theoretic chemistry	0	13	9
Experimental physics, first division	0	17	9
,, ,, second division ..	0	17	9
Botany, first division	0	17	9
,, second division	0	17	9
Zoology	0	17	9
Mineralogy	0	17	9
Pharmaceutical chemistry	1	1	0
Pharmacognoscy	1	1	0
Repetitorium on pharmacy	0	10	3
Chemical technology, inorganic division ..	0	13	9
,, ,, organic division ..	0	13	9

By this it will be seen that this Institution offers advantages not easily found elsewhere. Manufacturers and advanced chemists, who wish to perfect themselves practically in some special branches, will find no better opportunities than here, under so renowned a teacher, who is master of his art. Wiesbaden is one of the most charming places to live in, and as the surrounding country offers great advantages for the study of botany, weekly excursions are made by the professor of botany during the summer semester, giving a chance to each student to pursue his studies practically and collect a nice herbarium for himself.

May this good Institution long continue in its present flourishing condition, and may the young chemists issuing therefrom never forget their "alma mater," and in their future professional lives try and imitate their great teacher.

DRAPER AND TYNDALL ON THE INVISIBLE RAYS.

THE following appears in the *Scientific American*:—

In Prof. Tyndall's lecture on "The Invisible Rays," the following statements occur. "On both sides of the spectrum there is a copious overflow of rays which are incompetent to excite vision, but which, however, are able to agitate the molecules of certain substances so as to shake them asunder and produce chemical decomposition;" and, further on, "It is shown that the heat radiated from the

non-luminous portion is seven or eight times as great as from the luminous or visible." The latter proposition is illustrated by a well-known figure, in which the invisible rays are represented by a curve very large in comparison with a similar line indicating the visible rays. In the same number of your journal you publish Dr. J. W. Draper's researches in actino-chemistry, in which the author says—"As Dr. Draper demonstrated the heating power of radiation to reside in all equally, whatever their refrangibility, so in this he proves the power to produce chemical changes to be manifested by rays of every refrangibility, different substances being acted on by different rays." The discrepancy apparently existing between the views of Drs. Draper and Tyndall, thus plainly indicated by the two articles from which the above extracts are made, has led me to obtain a more extended report of the investigations of the former physicist. The conclusions therein contained seem to me to be flat contradictions of Prof. Tyndall's assertions, as proved by the following:—It follows that the true distribution of heat throughout the spaces of the spectrum is equal, and that "the figure so generally employed in works on actino-chemistry to indicate the distribution of heat, light, and actinism in the spectrum, serves only to mislead. The heat curve is determined by *the action of the prism, not by the properties of calorific radiations;* the actinic curve does not represent any special peculiarities of the spectrum, but the habitudes of certain compounds of silver." Can you or any of your readers reconcile such completely opposite ideas? How is it that Prof. Tyndall did not allude to so radically different a theory, of the existence of which he must have been aware, in the course of his lectures? When such eminent and learned doctors disagree, it is indeed a question who is to decide.—A Perplexed Physicist.

Remarks by the Editor.—The discrepancy between the views of Dr. Draper and Dr. Tyndall, pointed out by our correspondent, did not escape the attention of scientific men during the visit of the latter to this county; and the subject was frequently discussed by them without the friends of either party being able to reconcile the differences. Dr. Draper, we are told, is disposed to think that the spaces in and out of the spectrum measured by Dr. Tyndall were so small that the chance for error was a very close one, and he intimates that an error was probably committed. On the other hand, Dr. Tyndall does not appear to believe in Dr. Draper's results. We suspect that Prof. Tyndall did not allude to the radically different theory, of which he was fully aware, partly because it might have been considered a breach of hospitality and partly because the rostrum of a public lecture is not the place for the discussion of such nice points of physics. The question is one which can only be determined by actual experiment. The learned doctors must repeat their observations, and, if they still disagree, let a high court of arbitrators appoint competent physicists to go carefully over the same ground and report the results to a scientific congress. We take the opportunity to say that, in our opinion, Dr. Draper has never received the credit that fairly belongs to him for his early researches in prismatic analysis. In the *Philosophical Magazine* for May, 1847, and February, 1848, are contained papers "On Methods for the Prismatic Analysis of Substances," in which will be found foreshadowed Bunsen's application of the spectroscope to chemical analysis. Bunsen at first proposed to substitute prismatic analysis for flame analysis as an aid to qualitative chemistry. In this he had been anticipated by Draper, but Bunsen went further and discovered a new element; that event fixed the method beyond all possibility of being forgotten, and Kirchhoff clinched the matter by his magnificent researches in solar chemistry. Still it must not be forgotten that Draper pointed out this line of research fourteen years before Bunsen took it up, and that if he had not been loaded down with the cares of administration and the toil and drudgery of teaching, he too might have pursued it to such a degree of perfection that no subsequent doubt could have arisen as to his share in the great discovery. The present is a good time to revive these points of history, and to accord credit where it belongs.

CORRESPONDENCE.

DECOMPOSITION OF SULPHURIC ACID BY HYDROGEN IN THE PORES OF CARBON.

To the Editor of the Chemical News.

Sir,—I see that Mr. Skey, writing from New Zealand, thinks this apparent phenomenon is due either to the previous absorption of sulphuretted hydrogen from the atmosphere or from the presence of sulphides in the carbon.

If anyone will take a porous jar, with a plate of carbon in the middle packed round with broken pieces of carbon, and form it into a battery with amalgamated zinc, and dilute sulphuric acid for an electrolyte, and set it to work through a moderate resistance—say 20 ohms—for twelve hours, I think he will find the evolution of sulphuretted hydrogen too great to be thus accounted for.

An easy *experimentum crucis* would be to keep on renewing the sulphuric acid till all sulphides accidentally present must be fully decomposed, and seeing whether the evolution of sulphuretted hydrogen still went on.

Why should not nascent hydrogen, in the pores of the carbon, form, with sulphuric acid, water and sulphuretted hydrogen? It is quite according to the analogy of other chemical facts.—I am, &c.,

H. Highton.

Putney, March 17, 1873.

MANUFACTURE OF SULPHURIC ACID.

To the Editor of the Chemical News.

Sir,—In answer to Mr. McCulloch's observations in his paper on the manufacture of sulphuric acid (Chemical News, vol. xxvii., p. 135), allow me to say that with a *properly proportioned and worked* Glover's tower none of the drawbacks to its use mentioned by him exists. I have used a tower five years without interfering with the original packing, and after six years' constant use the lead is still in good condition. So far from the acid being imperfectly denitrated, or containing any of the higher oxides of nitrogen, it frequently smells strongly of SO_2. The same apparatus, in converting 1651 tons of sulphur (from Norwegian pyrites) into acid, required 63 tons 13 cwts. of nitre, or 3·8 per cent, chamber space being 1 S per twenty-four hours to 20 cubic feet, thus showing a much greater economy of chamber room than that described by Mr. McCulloch; at the same time *all* the acid so made was concentrated to 140° to 150° T. by the heat from the pyrites kilns alone. Similar apparatus, fitted up from our plans and under our advice, have given even better results than the above. Mr. McCulloch is right in his observation, that heat alone will not denitrate sulphuric acid, but concentration by heat *in an atmosphere of* SO_2 does it thoroughly.—I am, &c.,

John Glover.

Wallsend, Newcastle-on-Tyne,
March 24, 1873.

MISCELLANEOUS.

Dr. Fresenius's Laboratory.—Mr. Harry G. Shaw writes to say that a great jubilee, in commemoration of the twenty-fifth year of foundation of the institution of Dr. Fresenius's Laboratory, will be held from the 2nd to 4th May, where Bunsen, Liebig, Mohr, and other eminent Chemists, together with the former students of Fresenius, are expected to attend.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, March 17, 1873.

The following original papers and memoirs more particularly relating to chemistry are published in this number :—

Heat set Free by the Reaction of the Hydracids and Water, and on the Molecular Volume of the Solutions thus Formed.—This exhaustive monograph, elucidated by a large number of tables and algebraical formulæ, treats on the degree of heat developed by the union (combination) of chlorhydric, bromhydric, and iodhydric acids with water, and also on the amount of heat set free by the reaction of the caustic alkalies—potassa, soda, ammonia—with water. The heat set free by dissolving these substances in water, and also by diluting their concentrated solutions with water, has been measured with great care by the aid of a peculiarly constructed calorimeter, somewhat different from that applied to analogous experiments by Favre and Silbermann. The Berthelot calorimeter consists of an outer copper vessel, in which there is placed at some distance a similar but smaller one, the inside being plated with silver. The calorimeter, properly so called, which is made of platinum; is placed in this vessel; its capacity can be varied, and is comprised between 600 and 1000 c.c. The employment of this large calorimeter has the effect of perceptibly diminishing 1-200th of a degree during a quarter of an hour, the variation of temperature due to the action of other objects. The reactions to be investigated can be made in the calorimeter itself. By a series of experiments the author has found that the heat set free by the solution of any of the three hydracids varies in the ratio of the quantity of water already combined with the same; in other words, the quantity of heat set free in the solution, or in the mixture of a quantity of pure acid and equal quantity of water, is constant, and this holds good for the three hydracids.

On Spectrometry; Spectronatrometry.—P. Champion, H. Pellet, M. Grenier.—This essay, illustrated by woodcuts, treats on a spectrometrical process for the estimation of soda; but without the reproduction of the woodcut no further details can be given. There is added to this paper an appendix under the following title:—

On Quantitative Spectrum Analysis.—M. Janssen.

Critical Remarks concerning a Paper Recently Published by Gernez "On the Crystallisation of Supersaturated Saline Solutions.—Ch. Violette.

La Revue Scientifique de la France et de l'Etranger, March 22, 1873.

Contains no papers relating to chemistry, but attention is called to the following memoirs :—

Genealogical Classification of the Animal Kingdom.—Dr. Haeckel.

The Development of Scientific Medicine.—Dr. Cl. Bernard.

Bulletin de la Société Chimique de Paris, No. 5, 1873.

The original papers and memoirs published in this number having previously been published in the *Comptes Rendus* have been already noticed.

No. 6, 1873.

From the *proces-verbaux* of the meetings of this society we quote the following:—

Estimation of the Oxygen in Blood by Means of the Hydrosulphite of Sodium.—P. Schützenberger and Ch. Risler.—Blood kept in an atmosphere of hydrogen, and diluted with 100 times its own bulk of water previously freed from oxygen, was found to yield about one and a half times more oxygen than can be obtained from the blood—previously well mixed with air—by aid of exhaustion with the air-pump.

Isomers of Bibromo-Succinic Acid.—P. Franchimont.—For the purpose of priority the author briefly mentions that, while preparing bibromo-succinic acid at a temperature of 130° to 140°, he believes he has obtained two isomeric acids, which can be separated from each other by repeated crystallisation in boiling water, but then the isodibromo-succinic acid is decomposed into bromhydric and bromomaleic acids; by further causing sodacetic ether to act upon this acid there is formed aconitric acid. This latter—but obtained from acidbromomalate of sodium—the author has tried to convert into citric acid.

Carburets of the Terebic Series.—M. Ribau.—Pure tereben, prepared by Deville's process, has been more particularly investigated. The body alluded to consists of cymen, boiling at between 175° and 177° (due to the incomplete combustion of the tereben by the oxygen of the sulphuric acid), and genuine tereben, boiling at 155°, not possessed of optical rotatory power, becoming solidified by contact with hydrochloric acid, forming crystalline chlorhydrate of tereben isomeric with the corresponding chlorhydrate of terebenthene. The former body is decomposed by cold water, yielding hydrochloric acid and a new hydrocarbon, $C_{10}H_{16}$, in active β-camphen. Among other substances obtained by fractional distillation from the cymen is a solid material, which, in its physical properties, is similar to the camphor obtained from the *Laurus* species; it fuses at 169°.

Marsh-Gas from Methylic Alcohol.—E. J. Maumené.—The author states that by the incomplete combustion of methylic alcohol in a specially constructed apparatus, marsh-gas has been obtained by him.

Decomposition of Nitrate of Potassa by Continued Boiling of its Aqueous Solution.—E. J. Maumené.—Since Lavoisier's investigation of this subject, it has always been held that the loss experienced by the continued boiling (evaporation) of an aqueous solution of the salt alluded to is due to particles of that salt being mechanically carried off with the steam. But the author states that the result of his investigation is the dissociation of the nitric acid, and consequently the formation of caustic potassa, which is actually found in the solution.

This number contains no other original matter.

Les Mondes, March 20, 1873.

Hydrothermic Engine.—D. Tommasi.—From the short account here published it would appear that the author has constructed a mechanism, the motive power of which is derived from the expansion of oil by heat. A more complete description is promised shortly; but this contrivance seems to offer great advantages over steam, inasmuch as—(1) no explosions of boilers can take place; (2) 80 per cent less space is required for the apparatus; (3) cheapness; (4) economy of fuel.

Artificial Production of Ice.—P. Giffard and J. Armengaud.—With the machinery as now constructed, and as yet imperfect, the authors have succeeded in making 20 kilos. of ice per minute while working with a 5-horse power high pressure engine, so economically constructed that for 1 kilo. of fuel used 2 kilos. of ice are obtained. On this same subject the last-named author publishes a lengthy mechanico-physical essay.

Petites Annales de Chimie.—E. J. Maumené.—The thirteenth instalment of this monograph, this portion treating on the chemical action produced by the galvanic current.

Use of Ammonia in the Looking-Glass Amalgam-Covering Works.—J. Meyer.—The author states that the injurious effects of the mercury upon the workmen engaged in this so-called silvering—really amalgamising with tin and mercury—of mirrors and looking-glasses, may be prevented by sprinkling from one-half to 1 litre of strong ammonia every evening on the floor of the workshop.

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C., and 8, Houndgate, Darlington.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

614. C. Chanel, Rue de la Fidélité, Paris, "An improved fuel."—Petition recorded February 19, 1873.

684. S. Rowbotham, Kentish Town, London, and G. Richardson, Chignal St. James, near Chelmsford, Essex, "Improvements in the composition of artificial marbles, stones, and cements of every kind, in making them firmer, harder, less absorbent, and more able to bear exposure to air, water, and other influences than hitherto, which improvements are applicable to the making of paints, and as a substitute for leather and other like fabrics."—Petition recorded February 24, 1873.

743. R. K. Whitehead, Walmersley, near Bury, Lancashire, "Improvements in the manufacture of size."

744. T. Cadett, Rosherville, Kent, "An improved artificial fuel."—Petitions recorded February 28, 1873.

758. J. C. A. Henderson, Wood Street, London, "Improvements in the treatment of peat, and in apparatus therefor, part of which is applicable to other purposes."—Petition recorded March 1, 1873.

766. E. Hunt, Salford, Lancashire, "An improvement in dyeing and fixing what are known as aniline colours."—Petition recorded March 3, 1873.

783. E. Hunt and G. M. Hopwood, Salford, Lancashire, "Improvements in treating catechus, cutch, or gambier, to obtain products therefrom suitable for use in tanning, dyeing, and printing."—Petition recorded March 4, 1873.

795. W. R. Lake, Southampton Buildings, London, "An improved manufacture of coloured or ornamented paper, cloth, and other similar materials, and processes and compounds employed therefor."—A communication from F. Beck, New York, U.S.A.

799. B. Hunt, Serle Street, Lincoln's Inn, Middlesex, "Improved

processes for the extraction of iodine."—Petitions recorded March 5, 1873.

828. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of sulphates of soda and of potassa, and in the production of chlorine."—Petition recorded March 7, 1873.

INVENTION PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

803. W. Mickle, Tynemouth, Northumberland, "Improvements in smelting and puddling iron."—Petition recorded March 5, 1873.

NOTICES TO PROCEED.

3202. W. Thompson, Wandsworth Road, Surrey, "Improvements in the manufacture of white-lead, and apparatus therefor."—Petition recorded October 29, 1872.

3261. J. A. Wanklyn, Hampstead Road, Middlesex, "Improvements in the production of oxygen gas."—Petition recorded November 2, 1872.

3308. M. Rae, Uphall, Linlithgowshire, N.B., "Improvements in the production of artificial fuel, and in the machinery employed therein."—Petition recorded November 7, 1872.

3322. W. Marriott, Huddersfield, Yorkshire, "Improvements in the manufacture of salts and oxides of lead, and in apparatus therefor."—Petition recorded November 8, 1872.

3350. H. H. Murdoch, Staple Inn, Middlesex, "An improved mode of tanning hides and skins."—A communication from B. Picard, Paris.—Petition recorded November 11, 1872.

3736. W. R. Lake, Southampton Buildings, London, "An improved insulating compound for telegraphic purposes."—A communication from Z. G. Simmons, Kenosha, Winconsin, U.S.A.—Petition recorded December 9, 1872.

547. J. G. Willans, Bayswater, Middlesex, "Improvements in the manufacture of iron and steel."—Petition recorded February 14, 1873.

728. A. E. Webb, Stepney, Middlesex, "Improvements in candles and night-lights, and in the treatment of materials therefor."

732. J. G. Redman, New Brompton, Kent, "Improvements in compositions for preventing the corrosion and the fouling of ships' bottoms or other submerged structures."—Petitions recorded February 27, 1873.

PATENTS SEALED.

2569. B. W. Gerland, Ph.D., Macclesfield, Cheshire, and E. Johnson, Dartmouth Park, near Sydenham, Kent, "Improvements in the manufacture of sanitary charcoal, and the application thereof to the treatment of sewage."—Dated August 29, 1872.

2693. S. J. Mackie, Delahay Street, Westminster, "Improvements in the manufacture and storing of gun-cotton."—Dated September 11, 1872.

2704. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of sulphate of soda."—Dated September 12, 1872.

2855. J. McKelvie, Edinburgh, N.B., "Improvements in the manufacture of illuminating-gas."—Dated September 27, 1872.

3588. A. V. Newton, Chancery Lane, Middlesex, "Improvements in the manufacture of sugar, and in apparatus to be used therefor."—A communication from S. Dod, Havana, Cuba.—Dated November 28, 1872,

3843. G. Haseltine, Southampton Buildings, London, "An improved method of, and apparatus for, rendering and drying animal matter, deodorising noxious gases, and treating blood to utilise it for agricultural and similar purposes."—A communication from J. J. Craven, Jersey, N.J., U.S.A.—Dated December 18, 1872.

3919. T. Williams, Roath, near Cardiff, Glamorganshire, "Improved combinations of materials for the manufacture of fire-bricks, retorts, and crucibles, linings for furnaces, cupolas, and vessels in which great heat is employed."—Dated December 26, 1872.

50. P. Spence, Manchester, "Improvements in obtaining valuable substances derivable from residual liquors produced in the manufacture of alum from natural phosphates of alumina."—Dated January 4, 1873.

NOTES AND QUERIES.

Portable Dry Ink.—At a recent meeting of the Frankfort Polytechnic Association, Professor Boettger exhibited a novel kind of ink, which is admirably adapted to take on journeys and exploring expeditions. White blotting-paper is saturated with aniline black, and several sheets are pasted to form a thin pad. When wanted for use, a small piece is torn off and covered with a little water. The black liquid which dissolves out is a good writing ink. A square inch of the paper will give enough ink to last for considerable writing, and a few pads would be all that an exploring party need carry with them. As water is always available, the ink is readily made.

Extracts from Dr. Guyot, "On the Forms and Forces of Matter," *Phil. Mag.*, vol. xli., p. 405 *et seq.*:—

P. 408.—"The subject which I am about to attack is so vast and difficult to explain that I cannot commence it without having previously asked for the kind and patient attention of my readers. I shall certainly announce a number of propositions which will appear more than doubtful, and I cannot stop to discuss and prove them one by one; but, by the patience and kindness of my readers, they will become evident as they are developed. I therefore ask for provisional faith, and I think it is in harmony with the spirit of my readers to grant me this preliminary faith in regard to all matters advanced, with the reserved privilege of judicially deciding after having heard. In fact, knowledge acquired and established bases its arguments on the principles and facts which it has accepted." . . . . . "It is often observed that learned official bodies energetically and for a long time reject truths and facts which afterwards take first rank amongst those adopted by science."

P. 409.—"Atomic elements are exceedingly few in number; twelve or thirteen metalloids and forty or fifty metals suffice to give rise to the millions of varied forms of all the bodies which we know on the earth." . . . . . "Such is the totality of the forms assumed by pressible ponderable matter which is atomised (that is, groupe‖ in atoms), a totality which extends to the whole universe and occupies all space. I say that this matter grouped in atoms *occupies* all the universe; I do not say that it *fills* it, because the universe is *filled* by elementary matter,—simple, subtle, impressible, imponderable, not atomised or grouped in atoms. Not but that its element is an atom, for it is indeed the absolute atom; but this atom is free from all combination: it is infinitely more subtle than any atom of coercible matter.

"The existence of this incoercible matter has always been admitted by the greatest philosophers and the greatest physicists under the name of the subtle substance, or more generally æther.

"Æther, in fact, constitutes the fourth state and the fourth medium of matter. It is the most abundant of the states; it is the medium of media. It contains all the stars." . . . . . "All space void of coercible matter is occupied by it. Not only is there no such thing as an absolute vacuum in nature, but, on the contrary, ponderable and imponderable matter are in an absolute and relative condition of enormous tension. The equilibrium and the phenomena of the world only exist under the condition of the constant pressure of the incoercible matter upon the coercible matter, and the reaction of the coercible matter upon the incoercible."

"The approximation of the atoms of ponderable matter may therefore be due to the rarefaction of the imponderable fluid, and consequently to the diminution of its pressure in the space separating the atoms of the same body. And this approximation will be greatest and strongest accordingly as the interior rarefaction is greater, the exterior pressure being inversely as the interior. This hypothesis would be more than probable, it would be true, if it were shown that the vibration of the atoms of bodies may, and actually does, cause a rarefaction in the sphere of activity of each of the atoms.

"If this proof could be given, we should be obliged to admit that attraction is a mechanical force, composed (1) of the rarefaction of the æther in the interior of substances, of media, of heavenly bodies, brought about by the power of vibration of the atoms of ponderable matter; (2) of the reaction of the pressure of the exterior æther upon substances, media, and heavenly bodies—a reaction measured by the general tension of the imponderable and incoercible fluid which constitutes the mother-liquor *(Eaux mères)* of the world, the universal medium."

P. 418.—"That which occurs with vibrating bodies plunged in air ought to, and really does, occur in the case of atoms of coercible and ponderable matter plunged in æther, because no other explanation is possible of the phenomena of the formation of solid, liquid, and gaseous bodies, and of their transformation one into the other, of their elasticity, dilatability, solubility (affinities of the tension of media and of heavenly bodies), of the weight of bodies, of gravitation—in one word, of universal attraction,—and because this explanation is in accordance with those phenomena which we can see and measure."

MEETINGS FOR THE WEEK.

MONDAY, March 31st.—Medical, 8.
—— Chemical, 8. Anniversary.
TUESDAY, April 1st.—Civil Engineers, 8.
—— Royal Institution, 3. Prof. Rutherford, "On Forces and Motions of the Body."
—— Zoological, 8½.
WEDNESDAY, 2nd.—Society of Arts, 8.
—— Pharmaceutical, 8.
—— Microscopical, 8.
THURSDAY, 3rd.—Royal, 8½.
—— Royal Institution, 3. A. Vernon Harcourt, M.A., F.R.S., "On the Chemistry of Coal and its Products."
—— Royal Society Club, 6.
—— Chemical, 8. Dr. H. Sprengel, "A way of exactly Determining the Specific Gravity of Liquids." Dr. C. R. A. Wright, "On Cymene from various Sources." Dr. J. H. Gladstone and A. Tribe, "Researches on the Action of the Copper-Zinc Couple on Organic Bodies; II. On the Iodides of Amyl and Methyl." Dr. H. E. Armstrong, "Contributions from the Laboratory of the London Institution; No. XI. Action of the Acid Chlorides on Nitrates and Nitrites."
FRIDAY, 4th.—Royal Institution, 9. Prof. Tyndall, "Some Observations on Niagara, made during a Visit to the United States."
—— Geologist's Association, 8.
SATURDAY, 5th.—Royal Institution, 3. Prof. Max Muller, LL.D., "On Darwin's Philosophy of Language."

TO CORRESPONDENTS.

A Constant Reader.—The complete paper has been published in the *Brewers' Journal.*

H. Cant.—Erdman's *Journal fur Praktische Chemie* is a periodical of high value: it is now edited by Dr. Kolbe, but only occasionally are the various combinations of aniline mentioned. The journal is published at Leipzig, and is found in many of the libraries in this country. A work is in the press which will give all the information you require:

SUPPLEMENT
TO
THE CHEMICAL NEWS.
VOL. XXVII. No. 696.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 20th, 1873.

Professor FRANKLAND, D.C.L., F.R.S., President, in the Chair.

THE names of the visitors having been announced, and the minutes of the previous meeting read and confirmed, the list of donations to the Society was read. The names read for the first time were those of Messrs. James Hughes and Henry Tylston Hodgson, M.A.; for the third time—Messrs. Andrew F. Crosse, Thomas Futcher Best, W. Ramsay, James William Bantock, and Frederick Douglas Brown.

The President then called on Dr. SIEMENS to deliver his lecture "*On Iron and Steel.*" The lecturer first adverted to the discourse delivered by him before the Society in 1868, on the regenerating gas furnace as applied to the production of steel, briefly describing one of the processes for that purpose, viz., that of fusing the pig-iron on a hearth, which, in order to resist the great heat, should, like the vault, be of nearly pure silica, and then adding scrap-iron, which dissolves in the fluid metal, forming steel. He then proceeded to describe the action of the blast-furnace, which, notwithstanding the opinion expressed by Mr. Riley in his lecture, he must maintain was not the best apparatus, theoretically considered, for the production of iron, pointing out that the ore is reduced at a comparatively low temperature in the upper part of the furnace forming a kind of metallic sponge, which, as it sinks, comes to a hotter zone of the furnace and there takes up sulphur, phosphorus, and other impurities; moreover, there is an enormous loss of fuel, the carbon escaping at the mouth almost entirely (4-5ths) as carbonic oxide, and not as carbonic acid. A pound of carbon burning to carbonic oxide only evolves 2400 heat units, whilst if burnt to carbonic acid it evolves 8000 heat units; so that nearly two-thirds of the heating power is lost in the blast-furnace. Dr. Siemens also noticed the advantages of the hot blast, and the effect of introducing a secondary blast near the top of the furnace.

Considering that at the comparatively low temperature at which the ore is reduced to a metallic sponge in the blast-furnace, it does not become contaminated with the sulphur, phosphorus, and other impurities so detrimental in the production of good steel, the speaker had invented a revolving furnace in which the ore could be reduced in this manner, and then be allowed to fall into the pig fused on a hearth, as in the process previously described; but here a great obstacle occurred, from the light metallic sponge floating on the surface of the molten metal.

In order, if possible, to avoid the spongy state altogether, the experiment was tried of fusing the ore and running it into moulds partly filled with coke, so that the two might be intimately mixed. These bricks were then added to the molten metal on the hearth, in hopes that they would be there reduced and convert it into steel; it was found, however, that this was not the case, the effect being much the same as when ore was added unmixed with coke. It was therefore determined to fuse the ore, and while in this condition, to mix it intimately with sufficient carbonaceous matter to effect its reduction. This was done by fusing the ore in the upper hearth of a double furnace, and when melted, ladling or tapping it off on to the lower hearth, where it was mixed with the requisite quantity of powdered coke by manual labour in a manner analogous to puddling. It was then found that the iron was immediately precipitated from the molten mass in the metallic state. The hearth of this furnace was made of the ore itself, and the results obtained were satisfactory, but a great amount of manual labour was required to mix the ore with the carbonaceous matter. An effort was therefore made to obtain the desired result by machinery. The process was conducted in a revolving furnace lined with refractory bricks, capable not only of withstanding the intense heat required to fuse the ore, but also the action of fused metallic oxides. The bricks were made from "Bauxite,"—a mineral consisting chiefly of alumina with some ferric oxide,—mixed with about 5 per cent of plumbago and some silicate of soda. The ore is introduced into the furnace, which revolves very slowly at first, and is there heated to a very high temperature, but one insufficient to melt the iron peroxide; a portion of the coal, about 20 per cent of the whole, is now introduced, so as to reduce the charge to the state of magnetic oxide, which is comparatively fusible; the rest of the fuel is then added, and the furnace caused to rotate rapidly, so that the particles of iron precipitated in the mass may ball together. Three of these balls are produced in each furnace, by the interior lining having projecting ribs for that purpose. This process is perfectly successful in producing a wrought-iron free from sulphur, &c., and which dissolves in the bath of melted pig like sugar in water, forming a steel equal in quality to that obtained from the best Swedish bar. The economy of time and fuel also is very great, the whole operation only occupying about two hours, and the amount of fuel consumed being altogether about 1½ tons per ton of iron produced.

During the course of his masterly lecture, which was illustrated by numerous diagrams, specimens, and tables, the speaker compared the ancient process of smelting, as practised to this day in India, with the Catalan forge and the blast-furnace, and also explained why it was always necessary to add manganese (in the form of spiegeleisen) in his process for preparing steel, although it was not necessary in the Bessemer process if the iron already contained it. In the latter case the free oxygen blown in oxidised, by preference, the silicon and as much iron as would form a tribasic silicate, leaving the manganese untouched; whilst in the former instance, on adding oxide of iron to it, the manganese became oxidised.

The PRESIDENT said that the members, by their acclamations, had anticipated the vote of thanks he was about to propose to Dr. Siemens for his instructive lecture, the subject of which he had treated with such a master mind. He had conducted his experiments in the true spirit of philosophy, and had attained, what all philosophers did not, a most important practical result; for not only was he able to produce steel of such excellent quality, but at the same time used only a comparatively small quantity of coal.

Mr. L. BELL remarked that he was comparatively little acquainted with the working of the new process, but was surprised at the very small amount of fuel required to reduce the oxide of iron to malleable iron. He must confess to a great fondness for the blast-furnace, and should be sorry to see it replaced. It must be remembered that, although carbonic oxide is a powerful reducer, carbonic acid is a powerful oxidiser, therefore in the blast-furnace the conversion of the carbon into carbonic oxide was a defect inseparable from the process itself. The great mass of matter at the furnace above the tuyeres intercepts a great deal of heat, so that the gases issuing from the mouth had only a temperature of about 650°; moreover, the furnace being large and its sides thick, the loss by convection and radiation was small compared with what it must be in that of Dr. Siemens.

Dr. Siemens replied that he had been obliged to allude to the blast-furnace, in order to point out the advantages of the new method; he did not wish to decry the blast-furnace, which was in many respects an admirable instrument. The small amount of fuel employed in the regenerating-furnace is easily accounted for; in it the carbon is all burnt to carbonic acid, whilst in the blast-furnace it issues as carbonic oxide. Moreover, the temperature of the gas in the former case is 300°, in the latter 650°, so that, from the same amount of fuel, he obtained more than three times the calorific effect, and the gases passed out of the chimney at a temperature 350° lower, leaving a large margin for the difference in radiation and convection.

Professor Williamson remarked that, although the blast-furnace had been greatly improved, it was utterly faulty in principle. The greatest possible amount of heating effect was not obtained from the fuel, and, as Mr. Bell had confessed, if the gases were made hotter the carbon present was burnt by the carbonic acid to carbonic oxide. It was almost impossible to appreciate and recognise too highly the value of introducing correct principles into so vast a manufacture, as it was manifest that the lecturer had been enabled to do through the wonderful command of heat obtained by the use of his regenerating-furnace.

Mr. Riley said that he quite agreed with the remarks of Mr. Bell, and although this process might do for rich ores, he could not conceive how poor ones, such as the clayband, could be treated by it, from the great amount of cinder they would produce.

Mr. Mattieu Williams observed that he fully appreciated the great importance of escaping the spongy state, in which the metal so readily took up sulphur, &c., as some experiments he had once made would serve to illustrate. He had imagined that sulphur in the fuel employed in the puddling-furnace would be very injurious to the quality of the iron, and, in order to test this, he employed a poor coal as fuel, but found that it did not produce any change in the quality of the iron, and, even when considerable quantities of pyrites were thrown into the furnace, the effects remained the same. This might, perhaps, be explained by the coating of slag covering and protecting the iron from the action of the sulphur.

Dr. Siemens, in replying, said that Mr. Riley was right in supposing his description to apply to the richer varieties of ore, but he had worked poor ones. The Cleveland ores produce an iron chemically purer than when prepared by the blast- and puddling-furnaces. It is, however, with the richer ores that the saving is so great, since even very inferior fuels can be used. In reply to a question asked by Dr. Wright, he might say that the essential difference between the blast-furnace and the rotating-furnace was that in the latter the heat is not developed in the interior, but on the surface, of the mass, from which carbonic oxide is continually issuing during the reduction, so that the metal is protected from the action of the carbonic acid, whilst the burning carbonic oxide heats that part of the internal surface of the furnace which happens to form the arch, and which, as it rotated, would in turn become the bottom.

The President, after recapitulating the advantages of Dr. Siemens's process, adjourned the meeting until Monday, March 31, when the anniversary meeting will be held. The next ordinary meeting is on Thursday, April 3, when the following papers will be read:—1. "A way of exactly Determining the Specific Gravity of Liquids," by Dr. H. Sprengel. 2. "On Cymene from various Sources," by Dr. C. R. A. Wright. 3. "Researches on the Action of the Copper-Zinc Couple on Organic Bodies; II. On the Iodides of Amyl and Methyl," by J. H. Gladstone, F.R.S., and A. Tribe. 4. "Contributions from the Laboratory of the London Institution; No. XI. Action of the Acid Chlorides on Nitrates and Nitrites," by Dr. H. E. Armstrong.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

Inaugural Address of the President, Dr. Lunge, Ph.D., F.C.S.

(Concluded from p. 141.)

Unfortunately, the solution of sodium bicarbonate can hardly be utilised for obtaining solid bicarbonate therefrom; at least, I never succeeded in anything like that, and therefore proceeded to boil it down, during which process the second equivalent of carbonic acid is driven off, and can be collected in a gasholder or otherwise for further use. The dry residue of evaporation is furnaced, and constitutes an alkali of most complete purity, equal in colour to the best refined alkali, and surpassing it in the complete absence of all but traces of foreign salts, if the sodium sulphate had been sufficiently pure. It is well known that all traces of iron would be completely removed by the barium carbonate, which is a reaction utilised in analytical chemistry; no alumina, or silica, or lower sulphur compounds of sodium would ever get into the product at all. The quantity of soda thus obtained is the one to be expected theoretically from the sulphate employed; in my experiments I obtained sometimes as much as 99½ per cent of sodium carbonate, of the quantity calculated from the sulphate weighed into the apparatus, and allowing for the impurities of the latter. I need hardly remind you that the loss of available alkali in Leblanc's process, with the greatest care, amounts to 12 or 15 per cent of the theoretically obtainable quantity, partly in consequence of mechanical losses or volatilisation, but mostly in the shape of undecomposed or reformed sulphate, and of soluble or insoluble sodium compounds left in the tank waste.

I must mention at this point, that another Continental professor, Mr. C. Brunner, independently of me, and before my specification was published, has, like myself, proposed the reaction of carbonic acid on a mixture of sodium sulphate in solution and barium carbonate. I was, of course, on my part, perfectly unaware that Mr. Brunner was making such experiments whilst I was making my own; but I must say, having read his paper for the first time some time after my final specification was filed, that I could not have extracted any suggestions of value from it, even if I had seen it sooner. The Professor very naïvely says, that he must leave it to practical men to say whether his proposal is realisable in an economical point of view, in other words, whether it will *pay*, and you may judge of its value as it stands, if I tell you that he proposes, where native witherite should be unobtainable, to make artificial barium carbonate by first reducing barium sulphate in *crucibles*, with powdered coal and resin; that he prescribes to make the carbonic acid by means of hydrochloric acid, *very* naïvely remarking, that the whole of the hydrochloric acid obtained in the manufacture of the sulphate of soda would not be sufficient for this process, and that the sulphuretted hydrogen escaping in the decomposition of the barium sulphide does not give him so much concern as to elicit a single word from him about its disposal. After this, I need not say that Brunner's proposal is utterly theoretical, and, if I did not think my own process essentially different in this respect, I should not venture to lay it before this audience, even in the shape of a suggestion.

I should also mention that some time after I had taken out my patent, my attention was drawn to a patent obtained so far back as 1851, by Herbert Taylor, as a communication from a foreigner, not named. In that short specification, there are, among a whole heap of other things, five or six lines shadowing forth the same reaction; but, in the first instance, there are no details whatever given, nor is there the least hint how the reaction could be put into practice as part of a manufacturing process, and in the second instance, the addition that the use of the carbonic acid is *optional*, and the total ignoring of the formation of bicarbonates and the part they

play, shows that the matter in the mind of the unknown inventor had remained in a totally inceptive stage; and it is not to be wondered at that Taylor's statement has hitherto completely escaped the attention of the most diligent collectors of materials for the history of alkali making, to whom I herewith beg to make a present of it. I am quite unaware of the same reaction having been proposed anywhere else.

Brunner's most simple, if not very cheap, plan of obtaining his carbonic acid, leads me to say something upon the way in which I proposed to produce that gas. It is quite clear that the purer it can be obtained the better it is for the process. If, for instance, Ozouf's plan for obtaining pure carbonic acid were practicable on the large scale and sufficiently economical, it would come in very well for my process. Ozouf's proposal, it is well known, consists in pumping impure carbonic acid, mixed with any amount of air, nitrogen, &c., into a solution of ordinary sodium carbonate, when the foreign gases escape, whilst the carbonic acid is retained to form sodium bicarbonate. When the absorption has reached its maximum, the solution is drawn off and replaced by a fresh one; the drawn off liquid is in another vessel subjected to heat, the second equivalent of carbonic acid thus driven off, freed from steam by cooling, and then used for any suitable purpose. The residual liquid is again a solution of ordinary carbonate, and need only be cooled down to be used again in the absorbing apparatus. I have never put this method to the test, and do not know whether it is cheap enough, but I consider that the impure carbonic acid obtained according to the description in my patent, viz., by the burning of coke in connection with a lime-kiln, with the addition of the gas from boiling down the bicarbonate solution made in the main operation, does well enough for all purposes in my process. It must, of course, be forced into the "converters" by means of an air-pump, and before employment, it must be cooled down and washed the usual way. In any case, it will be quite impossible to absorb anything like the whole of the carbonic acid in one, or even in two converters (I always use two converters, each to be the first in turn), since, as I mentioned before, it is essential for such rapid work as would be necessary on a manufacturing scale to force the gas through the liquid in a strong and quick current. But here comes in a combination of apparatus which I devised for the purpose of completely utilising the carbonic acid. Behind the converters, and at a higher elevation, I place closed vessels, not necessarily provided with agitating shafts, in which I put a solution of barium sulphide obtained in a manner to be described anon. By using two such vessels one after the other, every trace of carbonic acid is taken out of the gas, and replaced by sulphuretted hydrogen, whilst barium carbonate is precipitated. When the whole of the contents of the first vessel has been converted into a milk of water and barium carbonate, the mixture is run out, first into a settling tank, in order to remove a portion of the clear water from the top of a thick mud of barium carbonate, and the latter is then transferred into any "converter" just ready to receive it, in order to serve for the main operation. The levels are arranged to suit this. Of course, the current of gas is then directed so as to pass first through the second vessel with barium sulphide, whilst the first one receives a fresh charge of the same, and serves as a second vessel for the final absorption of carbonic acid, till No. 2 is finished in its turn, and so forth. In the place of close vessels, through the contents of which the gas passes in bubbles and under pressure, it is quite possible to use scrubber-like columns without pressure, and I found them to answer much better for this purpose than for "converters;" but in practice I still prefer the former arrangement, as the initial pressure need not exceed in any case 15 lb. per square inch, which is both easy to attain and very favourable for the reaction. It is quite clear that ultimately we have in the escaping gas no more carbonic acid, but sulphuretted hydrogen mixed principally with nitrogen. I must candidly say that I have always seen the greatest difficulty of my process, and, indeed, almost the only important one, in dealing with the sulphuretted hydrogen in such a state of impurity. I tried, but in vain, Kopp's plan, to burn it with a limited supply of air, so as to produce water and sulphur, knowing beforehand that to try burning it completely for the manufacture of sulphuric acid would be useless. I further proposed to absorb it in "purifiers," like those in gas works, by hydrated oxide of iron, say, such as could be obtained from burnt pyrites, or from "purple ore." I also proposed as the most likely plan, to conduct the gas through a mixture of still-liquor and chalk, keeping the latter in sufficient excess to precipitate all manganese, and mixed with water into thin mud; the result would be the re-exchange of carbonic acid for sulphuretted hydrogen, and the formation of manganese sulphide, which might be converted by roasting into sulphate, and then serve instead of fresh still-liquor. In any case manganese or even zinc is for this purpose preferable to iron, since their sulphides are easily converted by calcining into sulphates, whilst iron sulphide could not very well be treated otherwise than by burning the sulphur into sulphurous acid, conducting this into lead chambers, and re-dissolving the residual iron peroxide in hydrochloric or sulphuric acid, clearly not a cheap process. In practice, I found that a mixture of still-liquor and chalk absorbed the sulphuretted hydrogen quite easily; but I never got so far in my experiments as actually to recover from the spent mixture the absorbent again, by drying and calcining the manganese sulphide. This last part of my process is, therefore, merely theoretical, but I really do not think that it presents any serious difficulties. I, of course, did not overlook that the sulphur, in this proposal, is lost, as well as in Leblanc's process; for, on repeating the operation, the chalk will be converted into calcium sulphate, and thus remove the sulphur from the sphere of utilisable products. The mixture of gypsum and manganese sulphate, resulting after calcination, would have to be treated with water, in order to separate the latter from the useless gypsum. There is nothing presenting any difficult aspect in all that; but I must repeat that this method of recovering the absorbent for sulphuretted hydrogen still wants the practical proof I was unable to make of it, and I am fully alive that this detracts a good deal from the value of my process, as the sulphuretted hydrogen evolved is necessarily equivalent to the whole of the alkali produced, and the absorbent, therefore, *must* be recovered, to enable working in a continuous manner. This will be all the more imperatively necessary when the present waste of manganese chloride, in the shape of still-liquor, will have ceased by the introduction of any of the new processes in that branch; but, even as it is, some alkali works produce no still-liquor at all, and not one can possibly produce an equivalent of it to the alkali made, if, as usual, the latter absorbs the bulk of the sodium sulphate manufactured.

I have not mentioned the absorption of the sulphuretted hydrogen by copper solutions, as in Gibb and Gelstharp's method; but this plan is evidently confined to exceptional circumstances. The sulphur is lost as well in this case, and that in the very objectionable shape of sulphurous acid escaping out of the stacks of the copper furnaces.

The last portion of my task is to deal with the baryta compounds involved in the reaction. The barium sulphate precipitated in the "converters" will, in most cases, be too much stained by the traces of iron usually accompanying commerical sulphate of soda, to be sold as "permanent white," which article is required to be perfectly pure; and as its consumption is quite restricted, in any case no large quantity of it could be disposed of. This barium sulphate must, therefore, be re-converted into carbonate, and this can best be done through the intermediate stage of sulphide. The first start would, of course, be made with native heavy spar, and the same material, which is cheap and frequent enough, would also have to make up any losses of baryta, occurring through imperfect reduction,

leakages, &c. Formerly, the reduction of barium sulphate into sulphide used to be considered hardly as a real manufacturing process; the operation was prescribed to be made in crucibles or retorts, and we see that Brunner, like most others, uses in it such an expensive material as resin. I have, however, convinced myself by many operations carried out in a furnace of the size of an ordinary ball-furnace, that the reduction can very easily be performed on the bed of a reverberatory furnace, especially if the oxygen of the air is kept out as much as possible by deep fire-places and tightly-fitting working doors, and that a mixture of baryta and coal dust of a not coking character is thoroughly efficient; the coking, by surrounding the single particles of baryta, impedes a perfect reduction. Of course, frequent stirring is indispensable, and nowhere would a revolving furnace be more in its place than here. I found that in this way upwards of 90 per cent of the baryta could be reduced, but on an average only 80 per cent were obtained. The unreduced barium sulphate is, however, not lost, as it remains behind when the reduced mass is lixiviated and is mixed with a fresh charge. The reduced mass is drawn out into iron barrows, quickly covered over till it cools, and lixiviated with hot water in a closed apparatus, preferably by means of a revolving shaft; and the resulting solution of barium sulphide is used for the production of carbonate by means of the excess of carbonic acid escaping from the "converters," as I have previously described it. As the charge never comes to the melting-point, and the heat required is only moderate, the action upon the furnace-bed is very small, nor is there any sensible loss of baryta by absorption in the same. Probably, some of my hearers will think it rather doubtful, whether this part of my process is practicable on the large scale, but I can assure them that just in that respect I have found no difficulty whatever; the reduction of baryta in reverberatory furnaces is carried out continuously in one or two works on the Continent, for special purposes, and I found the operation much easier than I had myself anticipated.

For the purpose of obtaining a clearer idea of my process as a whole, it may perhaps be desirable to recapitulate its salient features in a few words. Carbonic acid gas, made as rich and as pure as possible, is forced through a series of closed vessels, the first few, or "converters," containing a solution of sodium sulphate and barium carbonate, the next, which I will call "precipitators," standing at a higher elevation, and containing a solution of barium sulphide; the escaping impure sulphuretted hydrogen being dealt with in any of the manners shadowed forth above. The operation produces in the "converters" a precipitate of barium sulphate (which is afterwards reduced to sulphide and charged into the "precipitators") and a solution of sodium bicarbonate (which is boiled down and dried, yielding solid alkali and gaseous carbonic acid). The same operation produces in the "precipitators," by the action of the residual carbonic acid, the conversion of barium sulphide into carbonate, which is run in the state of mud into the converters, and serves for a fresh operation there. It might be suggested that the two operations could possibly be combined into one, avoiding at the same time the lixiviation of barium sulphide, by charging the latter as it comes out of the furnace into a solution of sodium sulphate, and conducting carbonic acid through it; but there are important reasons, which time prevents me to mention, why it is not advisable to do this.

I know I should fail in my duty, if I closed now, leaving my description as it stands, without telling you something about the economical aspect of the process. I will not say much of the plant, since this is a secondary consideration. It would, perhaps, be slightly larger than in ordinary alkali works, but then the repairs would be of a much lighter kind, the furnace work being so different. It is much more important to look at the expense of working. I would not like to say that my process allows a given quantity of sulphate to be worked up as cheaply as Leblanc's process; for the reduction of barium sulphate will cost about as much labour and coals as the balling process. The loss of baryta, however small, has to be made up, and carbonic acid cannot be had for nothing, even by taking it from a lime-kiln worked with coke; the saving of chalk, as against the balling process, would be most likely counterbalanced by a waste of the same in the absorbing process for the sulphuretted hydrogen. Labour, again, would be wanted rather more than for Leblanc's process, but of a cheaper kind, so that there would not be much to choose in that respect. But against these drawbacks you must set the following very important advantages:—Instead of losing 12 to 15 per cent of your alkali, you practically recover it altogether, as I have continually proved in my experiments, and as it is easy to understand; and secondly, what alkali you obtain is chemically pure, except any sodium chloride carried into it by the sulphate employed; but the alkali cannot possibly contain any sulphate, sulphide, or hyposulphite, nor any silica, alumina, or iron, as it is made in the wet way and only dried in a furnace. All you produce has, therefore, the quality of the very best refined alkali, such as is known in the trade as "calcined crystals." If, therefore, as I said just now, my process does not allow to work up a given quantity of sulphate as cheaply as Leblanc's process, on the other hand, the produce obtained is very much larger in quantity, and very much more valuable on account of its purity. In my opinion, which of course you are welcome to criticise to your heart's content, these advantages far outweigh the described and any minor drawbacks, provided that the sulphuretted hydrogen difficulty can be satisfactorily solved. That, in spite of this my opinion, I have had, as yet, no opportunity of practically carrying out my process, is caused by reasons beyond my personal control, and proves nothing either for or against. I have, therefore, thought it only right to make my process somewhat better known by this address, as it may, either as a whole or in part, prove after all a success in hands better able to take it up than I have been myself.

Mr. I. Lowthian Bell proposed, and Mr. Glover seconded, a cordial vote of thanks to Dr. Lunge for his Address, which was duly acknowledged.

NOTICES OF BOOKS.

A Course of Qualitative Chemical Analysis. By W. G. Valentin, F.C.S. London: J. and A. Churchill.

If the number of elementary works on chemistry—systematic as well as analytical—which now issue from the English press is to be taken as a guide, an increasing body of students are giving their attention to this important science, and we ultimately hope to behold a rich harvest of discoveries as the result of their labours.

The work before us commences with a short chapter on chemical operations. The reactions of the elementary bodies, both in the wet and dry way, are then given, each section being followed with appropriate "questions and exercises." We find useful synoptic tables of the behaviour of the groups and sub-groups of elements, and nineteen engravings of apparatus. There are also, for those whose taste inclines in such a direction, "graphic representations" of the constitution of various bodies. The book concludes with an appendix on the preparation and use of reagents; a table showing the solubility of salts in water and acids, and schemes for the systematic examination of simple salts and compound bodies. It will doubtless be fully appreciated by students, though the necessity or the propriety of introducing doubtful hypotheses into a manual of analysis is, to say the least, open to question.

THE CHEMICAL NEWS.

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ON A

NEW AND RAPID PROCESS

FOR THE

GENERATION OF SULPHURETTED HYDROGEN GAS FOR USE AS A REAGENT IN LABORATORY OPERATIONS.*

By W. SKEY, Analyst to the Geological Survey of New Zealand.

Sulphuretted hydrogen gas is in such constant use in all laboratories that I offer no excuse for submitting a new process for its generation, particularly as there appears to be a positive want for a better one than that at present in ordinary use. Indeed, owing to this want, several processes have lately been published for its preparation especially having for their object a combination of evenness and constancy of delivery, but I have not learnt that the advantages promised by their several authors have been realised in actual practice. In consequence it occurred to me to try whether the reaction of metallic sulphides with zinc in acidified water, described in the third volume of our *Transactions*,† could not be turned to account for the production of this gas. In that paper I stated that an evolution of sulphuretted hydrogen occurred under the above circumstances, the gas being thrown off from the surface of the sulphide used, while the zinc was *oxidised* and the sulphur of the sulphide *hydrised*, a true voltaic pair forming, as further demonstrated in an ensuing article.‡

This reaction, therefore, I applied in the following modified manner, and found it to answer so well that I am induced to make the process public for the benefit of practical chemists:—

Fragments of galena and granulated zinc, in proportions of about 1 to 1, are well mixed and put into a small apparatus of the kind generally in use for the preparation of this gas, and hydrochloric acid diluted with water (1 to 20 or so) poured upon them. Sulphuretted hydrogen is instantly given off, and its evolution is found to proceed energetically, regularly, and continuously for a great length of time—a length proportionate to that of the quantity of material used and its proper adjustment as to parts. A little hydrogen accompanies the gas named, and traces of hydrochloric acid. The acid is, however, easily removed, by allowing it to pass through a little carbonate of lime before use, while the presence of hydrogen can have no bad effect for all ordinary purposes.

After a sufficiency of the gas has been used it is best, in ordinary cases, simply to wash the galena and zinc with water, when the apparatus is ready for further use at a moment's notice; but when quantities are required in rapid succession a form of apparatus may be used which allows the separation of the acid liquid from the undecomposed substances within itself, when the delivery tube is closed. But a still more excellent method may be had recourse to in such cases, and this is to make the necessary electric contact of the zinc with the sulphide dependent upon the juxtaposition of movable wires carried outside the apparatus. For this it is only necessary to use them in mass instead of in fragments, connecting them electrically by means of wires, which are passed through the cork of the apparatus, and which are only allowed contact with each other by means of proper connecting screws.

If care is taken to keep the zinc and sulphide from direct contact, the evolution of gas instantly ceases on disconnecting the wires, and commences on making the connection.

For this last method it is necessary to amalgamate the zinc. I should state that any sulphide which is an electrical conductor may be substituted for galena, such as sulphide of iron or copper, but for cheapness and general convenience I recommend galena. Some kinds of commercial FeS yield HS more readily than others, a circumstance I find generally due to presence of free iron, a voltaic pair being thus presented to the acid (NS).

Having used this method during the last two years a great number of times, I have no hesitation in recommending it as a most simple, expeditious, and enconomical one, easy of control, and capable of delivering the gas equally, continuously, and vigorously; and I am authorised to state that Dr. Hector's experience of it in the Colonial Laboratory testifies to the correctness of these assertions.

* Read before the Wellington Philosophical Society.
† See *Trans. N.Z. Inst.*, vol. iii., p. 222.
‡ *Ibid.* p. 232.

SUPERFICIAL VISCOSITY OF LIQUIDS.

The idea of a viscosity proper to the surface-layer of liquids was first advanced by Descartés, and has been held by Rumford, Link, Prechtl, Hagen, Nageli, and others: some of whom have thought the property limited to water, while others have considered that all liquids have a greater viscosity in their surface-layer than in their interior.

M. Plateau some time ago made a series of experiments which satisfied him of the existence of superficial viscosity in certain liquids, as water, saline solutions, &c., and solutions of saponin, albumen, and various soaps; while there were others, as alcohol, ether, essence of terebenthine, &c., which had less viscosity at the surface than in the interior.

The principal form of his experiments was as follows:—About the middle of a cylindrical glass capsule was pivoted a magnetic needle. Liquid was poured in till it reached the needle; the latter was then moved 90° out of the magnetic meridian and left to itself; and the time taken by it to return through a certain angle was noted. Next, more liquid was poured in so that the needle was submerged; and its motion was, similarly, observed under these new conditions.

In a recent memoir, M. Marangoni called in question the truth of M. Plateau's inferences. He holds that all liquids have the same viscosity in the superficial layer as in the interior; and considers the resistance to motion on the surface is due, in the case of such liquids as water, which do not give bubbles by insufflation from a wide-mouthed tube, to the capillary action of meniscuses attaching to the needle, and in the case of liquids which give bubbles easily, to the presence of a pellicle of more or less solid nature.

Thus, consider the former case. Suppose concave meniscuses along the sides of the needle, and that the needle moves from left to right, on the surface. Then, on the right, the liquid tends to be raised as it is propelled by the solid, and so the meniscus will become less concave, or even convex. On the left side, again, the solid leaves an empty space and the liquid falls, so that the meniscus becomes more concave than before. And as the attraction of the meniscuses is proportional to their curvature, it follows from the decrease of curvature on one side and increase on the other, that the body is held back retarded.

M. Plateau's reply is, in substance, as follows:—

First of all, this assertion about raising of the liquid and increased volume of the right meniscus might hold good if the needle were partly immersed. But it merely touches the surface; and what it pushes before it is merely the meniscus. Now the friction at the base of

this meniscus, with the subjacent water, generates a resistance which tends to hold back the meniscus, and so, to diminish its volume by causing part of the liquid forming it to pass under the needle; a deduction quite contrary to that by M. Marangoni.

It might perhaps be replied that the solid attracts a body of liquid under it, which acts in the same way as if a portion of the solid were submerged. But if it were so, then in all liquids, and especially in those which have greater viscosity than water, this action should be observable in the motion of a small floating body a little in advance of the needle, before the needle meets it; now in essence of terebinthine, which is much more viscous than water, and in which the needle moves three times more quickly on the surface, no such advance motion is perceived.

No such deformation of the meniscuses has been observed by M. Marangoni. If any considerable changes of the kind occurred, they need not pass undetected. And even supposing the maximum change, it would not be sufficient to account for the resistance which appears.

But further; one proof which was adduced of the superficial viscosity in certain liquids was, that when the needle turned, the whole surface turned with it in the same direction, though more slowly. This could be seen, if lycopodium were sprinkled on the surface. To this fact, M. Marangoni makes reference in his memoir, and states that he will afterwards show it is not inconsistent with his theory. But the only thing connecting itself with this promise appears to be where he says that water sometimes presents a resistant pellicle; that, *e. g.*, well water became covered with a pellicle of calcareous carbonate; that water several times distilled may be exposed six or eight days to the air, without sensible increase of superficial resistance, but that after twelve days, the motion of the needle is twice as slow, and that twenty days later the fine dust of the atmosphere will have formed a pellicle so resistant, that the needle, moved 90° from the magnetic meridian and left to itself, will remain in that position.

But if the rotation of the surface of distilled water be attributed to the presence of a pellicle, what occasion was there to introduce the problematical action of the meniscuses? The pellicle would sufficiently explain the resistance to the needle. On the other hand, what origin is assigned to this pellicle? If atmospheric dust, and it be said that during the earlier days there was not any appreciable pellicle to resist the needle, it was yet of importance to M. Marangoni's theory to ascertain that the surface did not turn with the needle; but this was not done.

Now, in my former experiments with distilled water (says M. Plateau), in which series of ten measurements were made of the time taken by the needle on the surface, there was not apparent the slightest tendency to increasing viscosity. In experiments since made, the time was noted which elapsed from the moment at which the liquid was poured into the capsule till the moment the needle was first left to itself; also the time required in the series of ten measurements. The former was about five minutes, the second about six. Now if a pellicle formed, it could only be from some impurity in the liquid, whether existing in it previously, or arising from contact of water with the metallic parts of the pivot. But in any case the pellicle would have had to form gradually, and, according to the results, it would have had to acquire in five minutes a consistence sufficient to cause rotation of the whole surface along with the needle, and must not have sensibly increased during the six minutes following.

It might perhaps be said that the pellicle existed in the vessel from which the liquid was taken. To remove doubt on this point, a quantity of distilled water, much greater than that needed for the needle experiment, was poured into a large funnel-shaped vessel; the vessel was covered, and allowed to remain thus twenty-four hours, after which a stopcock being opened at the bottom, a portion of the water was allowed to flow (rapidly at first, then slowly) into the capsule till it reached the needle. A little gold dust was sprinkled on the surface, and the needle experiment was immediately made; the whole surface was observed to rotate. The experiment, from opening of the stopcock, only lasted four minutes. Here, it is evident, the water received into the capsule was taken far below the surface of the liquid in the larger vessel, and could contain nothing of the pellicle—if such existed.

Once more, it has been ascertained that the tension of distilled water diminishes rapidly when the liquid is contained in an open vessel; M. Hagen has observed it to descend, in a few hours, from 7·53 to 4·69: consequently, if the resistance to the motion of the needle had for its cause the action of the meniscuses, and if, therefore, the tension of the water played such an important part in the phenomena as M. Marangoni supposes, this physicist should have found a decrease of resistance in the distilled water exposed to air.

The superficial viscosity of water, then, and liquids of the same category, is, according to M. Plateau, sufficiently demonstrated.

Passing next to liquids which allow of being inflated in large bubbles, *i.e.*, solutions of saponin, albumen, and various soaps, M. Marangoni here distinctly applies his theory of pellicles. One of his experiments was as follows:—Having poured into a small capsule a little of a solution of saponin, and using a glass tube 15 m.m. diameter, one end of which was dipped in the liquid, the first bubbles obtained were pretty large, in some cases 10 to 15 centimetres, but those following were successively smaller and smaller; and after fifteen or twenty extractions of the liquid with the tube, it was no longer possible to produce bubbles. These effects, however, he has subsequently admitted, were only got when the solution was highly concentrated.

In another part of his memoir he says:—"If the solution of saponin be poured out after inverting the vessel, so that the superficial portion of the liquid does not escape, one would not obtain even the smallest bubbles."

On this M. Plateau remarks, that he made such an experiment, but with additional precautions. If the thing were done as M. Marangoni indicated, and bubbles were obtained, it might perhaps be said that, as air penetrated while the liquid was flowing out, this air traversed and agitated the mass, and mixed with it more or less of the substance of the pellicle.

Now, the formation of a pellicle in the saponin solution, if such there were, would necessarily be due, either, as M. Marangoni held, to the evaporation of the water, or to the fact that the solution contained a great number of small solid invisible filaments, which gradually rose to the surface and accumulated there.

The funnel-shaped vessel above referred to was filled with a saponin solution, covered, and left at rest for an entire week, that any filaments in the liquid might have time to rise to the surface.

The tube employed for blowing was of glass, and about 20 m.m. diameter. Before using it, the orifice was carefully cleaned with alcohol and distilled water, so that it was readily moistened by the solution (the strength of which was $\frac{1}{100}$.)

The stopcock was quickly opened, and a portion of the liquid withdrawn into a little capsule; there being thus, of course, neither entrance of air nor agitation of the upper part of the mass in the larger vessel.

On immediate trial of the withdrawn liquid, it gave bubbles of the following diameter, successively (in centimetres): 5, 5, 7, 6, 6, 8, 7, 7. The capsule was then emptied and dried, and a new portion of the solution withdrawn. The diameters of bubbles from this were: 6, 4, 4, 6, 6, 8, 9.

Here, then, M. Plateau points out liquid taken from under the surface gives bubbles, and these bubbles cannot be attributed to the presence of a pellicle, there being no time for the evaporation of water necessary, nor for the

rise of any remnant of filaments to the surface. And it would be irrational to argue some mysterious and sudden action of the air; if there were such, it would no doubt continue, and yet, after an exposure of two hours, there is no sensible increase in the diameters of the bubbles.

The tube was, in addition, applied to the surface of the liquid remaining in the larger vessel; and the diameters obtained were: 7, 6, 7, 7, 9, 6. Here there is a slight tendency upwards, which was doubtless owing to some impurity which gradually produced a slight pellicle on the surface.

M. Marangoni says, that if the vessel containing the solution be made to turn on its axis, the superior surface turns with it, while the subjacent liquid remains almost still; the small air bubbles raised on the surface take irregular forms, and if a bubble be blown from the orifice of the tube, and the tube be then left open, the bubble becomes wrinkled, and takes the form of a cone. But all these phenomena, it is replied, can as well be accounted for by a proper superficial viscosity as by a pellicle.

The solution of albumen presents the same phenomena as that of saponin, and therefore the same remarks must apply to it, as also to other liquids of the same category.

As regards a solution of Marseilles soap, M. Marangoni has found that after an hour and a half the time taken by the needle on the surface is nearly decoupled, and that after twenty hours the needle no longer moves. He supposes, therefore, a resistant pellicle to form on the surface, being produced by the action of carbonic acid and air.

This inference M. Plateau disputes. If the needle were not carefully cleaned after each experiment, it might happen that the solution, especially if containing chloride of sodium, would act chemically on it, and thus produce a pellicle of foreign nature, Thus, too, M. Piateau found that with a solution of chloride of calcium the time taken by the needle gradually increased, but when the needle was coated with varnish, this increase was no longer observed. Besides, even supposing the pellicle formed in the soap solution to be independent of chemical action on the needle, M. Plateau would not admit that it is this same pellicle which, with a fresh solution, produced the resistance which he observed to the motion of the needle.

The particulars in the foregoing account are taken from a paper recently communicated by M. Plateau to the Belgian Academy of Sciences. A. B. M.

ON THE MANUFACTURE OF SULPHURIC ACID.

By GEORGE LUNGE.

I DO not think it would be right to let Mr. McCulloch's paper "On the Manufacture of Sulphuric Acid," reprinted in your columns these last two weeks, go forth uncommented to the world, as it might thus seem as if the generality of "practical" men on the Tyneside agreed to his views on this important industry, whilst the contrary, in many respects, is undoubtedly the case. I leave other matters to others, and confine myself here to Mr. McCulloch's statements about the respective merits of "steam columns" and "Glover's towers" for denitrating the so-called nitrous acid. I should be very much mistaken if any reader of Mr. McCulloch's paper, previously unacquainted with the facts, could gather from it that the only works of any importance on the Tyne where "steam columns" are used for denitrating is that of Messrs. Allhusen, from which Mr. McCulloch's experience is *exclusively* derived; and that, not only in all other Tyneside works "Glover's towers" are used, but that the *last* acid plant built at Allhusen's likewise contains such towers instead of steam columns. From this fact alone it will be apparent to outsiders that Mr. McCulloch's strong advocacy of steam columns is not shared by any of his colleagues, and, indeed, his objections to "Glover's towers" are mostly very easily refuted. The starting of chambers is just as easy in one case as in the other, by introducing an extra quantity of nitre; and it is just as easy in one case as in the other to provide for the case of laying off the denitrating plant for repairs. As for the nitrogen compounds retained in the sulphuric acid after leaving the denitrating apparatus, there is not much to choose between steam columns and Glover's towers: some manufacturers actually work with less loss in the latter; and at any rate the experience of those who have worked practically according to both systems (which Mr. McCulloch has not done) is, that the consumption of nitre with Glover's towers can be kept at least as low as with steam columns. Mr. McCulloch seems to assume that the only denitrating elements in the former are heat and dilution; but if he did not look down so much upon the "rule of three" as against his cherished "rule of thumb," he would have taken into account the action of the sulphurous acid, which is quite as important, if not more so, than that of heat and dilution in denitrating the acid. Although he does not believe that it is possible to work properly without diluting the acid, I can assure him that, for special purposes, I have done so for many weeks in succession, and am doing so at this moment, with very satisfactory results. The acid is not quite so well denitrated as if it were diluted; but that does not matter very much, as it is used over again in the absorbing column. And I can also emphatically assure Mr. McCulloch and his readers, that if *he* despises the "rule of three" anent the testing of his acids for nitrogen compounds, not only myself, but many of my colleagues, find very great comfort and help in it in the knotty task of keeping sulphuric acid chambers in good working order.

The two principal advantages of Glover's towers, which have caused them to be so generally adopted, are the saving of coals and wear and tear for boiling down, and the avoiding of all loss of acid in that process, all vapours being carried away into the chambers.

I would, however, not close my paper without acknowledging that there are a few valuable hints to acid-makers in the paper, one portion of which I have felt bound to criticise as above.

South Shields, March 24, 1873.

THE SODA PROCESS, AND PROPOSED IMPROVEMENTS.*

By D. HILL.

WE have, in the full list of papers just issued, the most gratifying prospect of continued interest in the meetings of the Society. It will be observed that most of the papers to be read are upon some branch of the alkali manufacture or processes akin thereto, and it occurred to me that I might, without trenching on these subjects, give a short sketch of some of the processes which have been suggested from time to time to supersede or radically alter the present soda process.

The processes that have been proposed for this purpose may be arranged in six classes—

In the 1st class we have the processes which obtain, by one simple reaction, either soda or its carbonate from common salt.

The 2nd class embraces attempts to obtain soda from its other natural sources, such as cryolite, felspar, and nitrate of soda.

The 3rd class obtains soda from other salts of soda than the sulphate, or by treating common salt by other acids than the sulphuric.

The 4th class obtains soda from the sulphate in the wet way.

The 5th class contains all those processes which aim at

* From the President's Inaugural Address read before the Tyne Social Chemical Society.

recovering the sulphur of the sulphate, either by balling the sulphate with some metallic oxide, or by treating a solution of sulphide of sodium with a metallic oxide, and the processes which decompose the sulphide by carbonic acid.

The 6th class simply aspires to produce sulphate of soda from common salt in some other way than that at present followed.

It would greatly exceed the limits of an address such as this, to enter into the details of all the processes embraced in these classes. There are nearly fifty distinct processes, and several of them have been improved upon a dozen times by different discoveries. It will suffice to enumerate the chief processes that have been proposed, and where there seem to me points of sufficient interest, to discuss them as briefly as possible.

To obtain soda direct from common salt has always been a tempting field for the chemist. The celebrated Swedish chemist, Scheele, obtained soda by triturating a mixture of litharge and salt with water, and he afterwards used oxide of zinc instead of the litharge. This process, as you are aware, was revived by Bachet in 1869, and he claimed in his patent the improvement of mixing caustic lime with the litharge and salt, so as to obtain an increased quantity of soda from the common salt, and to facilitate the recovery of the litharge. Bachet's process was first submitted to the Jarrow Chemical Company, and after some experiments in their laboratory, it was rejected by them on account of the great consumption of fuel which the process would involve in separating the small quantity of soda from the excess of common salt, and from the known difficulty of separating the last portions of common salt, so as to obtain a marketable caustic soda. This opinion was amply confirmed by the later and more extensive experiments at the Walker Alkali Works. By Scheele's process only about 5 per cent., and by Bachet's process from 8 to 10 per cent. of the soda in the common salt used is converted into caustic.

The valuable papers read by Mr. Clapham at the Newcastle Chemical Society, give some interesting information on the difficulties encountered at the Walker Alkali Works in recovering the litharage from this process.

The decomposition of common salt in solution by carbonate of potash was at one time practised in this country, carbonate of soda and chloride of potassium being obtained, but the low price to which the latter salt has gone since the development of the Stassfurth potash deposits, precludes the possibility of this process being followed again.

Few of the soda processes can claim to have been better investigated, and certainly none have offered more attractions, than the process patented by Dyer and Hemming in 1838, to obtain bicarbonate of soda by treating common salt in solution with bicarbonate of ammonia. It would seem from what was communicated by Hemming to Prof. Brande, and published by him in the fifth edition of his "Chemistry," that these chemists sought to obtain soda-ash and sal-ammoniac by this process, although they indicate at the same time the means they employ to recover the ammonia to react upon fresh portions of common salt. Schlœsing, 1854, Johnson, 1854, Belford, 1855, Schlœsing and Rolland, 1858, Solvay, 1863, and Young, 1872, are some of those who claim to have improved upon this process, most of them claiming to have invented special apparatus for conducting the process. This reaction has the great advantage of being complete, and the only loss of soda sustained is that of the portion which remains as bicarbonate of soda in the solution of chloride of ammonium, which results from the reaction. The complete recovery of the ammonia has been stated to be the chief difficulty in the application of this process hitherto, and certainly any considerable loss of such a valuable substance would tell heavily against the adoption of the process, but it is possible, one would think, to construct apparatus now-a-days with economy which would obviate this, if it was the only difficulty. The point about this process which seems to me of chief interest, is whether the bicarbonate of soda can be obtained sufficiently free from alkaline chlorides to render it capable, by the removal of these hygroscopic substances, to enter the market as bicarbonate. The difference in value of soda as carbonate and bicarbonate is very great; the carbonate containing 52 per cent of soda, and the bicarbonate containing about 38 per cent, are about the same value. The announcement some time since in the "Glasgow Herald" that Mr. James Young had invented a new process for obtaining soda without the agency of sulphur, created a sort of panic in the shares of the Tharsis Company; but on the explanation being given that Mr. Young only claimed to have contrived new apparatus for conducting an old process, the Sulphur Company's shares returned to their propriety. The publication of Mr. Young's specification on this process will be eagerly watched for. Elliot obtained a patent in 1854, for the decomposition of common salt by the bicarbonates of lime and magnesia, of which little is known. The fact that magnesia salts are not precipitated by bicarbonate of soda throws an air of probability over the reverse process.

It was proposed by Sheridan, in 1837, to obtain soda by treating common salt in vapour with highly-heated steam, and later by R. W. Swinburne in 1862, to pass superheated steam over fused common salt, and although this reaction undoubtedly takes place, the extent of it, or the duration of the process necessary to complete it, combined with the difficulty of making apparatus capable of resisting the action of soda at such high temperatures, makes it very doubtful whether such a method will ever attain to a manufacturing process.

Powers and Dale, 1863, have endeavoured to work Swinburne's process by mingling iron with the salt.

Several patents have been taken out to decompose salt by electricity, by Cook in 1851, Watt in 1851, and Stanley in 1853, but until we are better able than at present to convert the latent energy of coal into electricity these processes must belong to the land of dreams. There are three processes mentioned in Richardson's and Watts's "Technology" to decompose salt—by potash, Hagen, 1768; by caustic baryta, Bergmann; and by caustic lime, Cohauson—of which, to say the least, the reactions are doubtful: we know at all events that one of the most convenient ways for obtaining caustic baryta is to treat a solution of chloride of barium with caustic soda.

The processes of the second class have but a limited interest. The decomposition of nitrate of soda by carbonate of potash to obtain saltpetre yields carbonate of soda as a by-product; but this process can only be expected to pay in times of great wars, when saltpetre commands an extravagant price. It is said to have been used during the Crimean War, and afterwards during the American Civil War. An interesting fact regarding nitrate of soda, which I am not aware has been previously published, is that its solutions at a high temperature are converted by metallic zinc into caustic soda and ammonia, with production of hydrated oxide of zinc. If we could readily recover the zinc in the metallic state, this reaction might be utilised in the present high value of ammoniacal salts. The preparation of carbonate of soda is not likely again to be attempted by reducing the nitrate of soda with charcoal. Heard, in 1838, proposed to obtain soda and nitric peroxide from nitrate of soda, by treating it with melted lead.

The preparation of caustic soda from cryolite at one time excited considerable attention, by the treatment of this mineral with lime in boiling mixtures; but its limited occurrence, and the small quantity of soda obtainable from it, put it out of the question as a considerable source of soda. Until the more valuable alkali potash has been economically extracted from felspar, it would be vain to hope for this as a source of soda.

The processes of the third class are all comparatively recent; the oldest probably is that of Samuel, in 1838, who proposes to decompose common salt in the wet way with oxalic acid, and to treat the resulting oxalate of soda with lime to obtain caustic soda; the resulting oxalate of lime

he decomposes by sulphuric acid, and obtains oxalic acid and sulphate of lime. Margueritte employs oxalic acid in the same way, and also proposes to use boracic and phosphoric acids to decompose common salt; and obtains a solution of caustic soda from the borate or phosphate by treatment with lime: to recover the boracic acid he decomposes the borate of lime by carbonic acid, or with hot hydrochloric acid; in the latter case the boracic acid crystallises from the solution on cooling. To recover the phosphoric acid he treats the phosphate of lime with chloride of lead, producing phosphate of lead and chloride of calcium; the phosphate of lead is then treated with hydrochloric acid, resulting from the decomposition of the common salt, and so obtains phosphoric acid for a fresh decomposition of salt, and chloride of lead for treating a fresh portion of phosphate of lime. This process, in fact, professes to decompose salt continuously with the same phosphoric acid and lead, obtaining caustic soda and chloride of calcium as a waste product.

However ingenious these processes are, it must be borne in mind, that however valuable caustic soda may be, it will not do to employ bodies in its preparation which have four or five times the value, such as oxalic and boracic acids, especially as in the processes proposed losses of these bodies must be sustained, and to reduce these losses to a minimum, long and costly processes of separation would require to be followed. If Margueritte's phosphoric acid process is worth anything at all, it seems to me that the most desirable form that it could take at the present day would be to obtain phosphoric acid by means of sulphuric acid from a mineral phosphate, to decompose salt with this acid, treating the resulting phosphate of soda with lime to obtain, as final results of the process, caustic soda and precipitated phosphate of lime; the latter, from its finely divided and highly concentrated state, would command quite as good a market as the same proportion of phosphoric acid in the soluble phosphates of artificial manures. Spilsbury has proposed to obtain caustic soda from tungstate of soda by means of lime, and Newton has proposed to prepare fluosilicate of soda with the view of obtaining caustic soda by treating it with lime.

Sulphate of soda can be partially converted into caustic soda by prolonged boiling with lime.

Two processes have been proposed which strictly belong to this class, but are closely related to the first class of processes. Blanc and Bazille take a mixture of common salt and sand, heat it to redness in an iron cylinder, and pass steam into it at such a rate as will not cool the mixture below a cherry-red heat, and by this means they obtain hydrochloric acid, which is carried away from the cylinder by a pipe as it is produced, and there is left in the cylinder on the completion of the process a neutral silicate of soda which is insoluble in water, so that if any salt should escape decomposition it may be removed by treatment with water, before attempting to render the soda soluble; which is accomplished by heating the silicate to redness in a furnace with two-thirds of its weight of carbonate of soda. By this means a mass is obtained soluble in hot water, which on treatment with carbonic acid gives a solution of carbonate of soda and a gelatinous precipitate of silicic acid. The other process, that of Tilghman, substitutes alumina for the sand in Blanc and Bazilles process; the heating in cylinders and treatment with steam is practically the same; the resulting aluminate of soda was moistened with water and exposed in chambers to the action of carbonic acid, and by treating the product from this operation with water a solution of carbonate of soda was obtained, and the insoluble alumina left behind was capable of use for a fresh treatment of common salt.

These processes attempt to remedy the dangerous effects of soda on the apparatus, at the high heat at which it is separated from common salt by the action of steam, by presenting to it something capable of combining with it at the instant of decomposition, and these bodies have doubtless the additional advantage of keeping the particles of salt asunder, thereby facilitating the action of the steam. Alkali of low strength only has been produced by the latter process when tried on the manufacturing scale.

The fourth class of processes consists for the most part in treating a solution of sulphate of soda by baryta or its carbonates, to obtain caustic soda, or carbonate of soda.

Fuller, in 1819, was the first to suggest the use of caustic baryta for obtaining soda; at that time carbonate of soda was the only saleable form of soda, and he converted the caustic into carbonate by carbonic acid; since that time caustic soda has become one of the principal, and at the same time one of the most valuable, marketable products of an alkali work. The attention which this process has commanded therefore need not be wondered at, or that the preparation of caustic baryta, by some cheap means, from its sulphate should continue to absorb the attention, as it is the dream, of some chemists.

Caustic baryta decomposes sulphate of soda with one equivalent, and has the further advantage of decomposing a solution of any strength, so that liquors can be obtained by it without having to pass through a concentrating process before running into the pans in which the caustic is finished. In this, as in all the processes in which baryta is used, sulphate of baryta is obtained from which the baryta must be recovered, as it is too valuable to waste, and, indeed, one chemist proposes to sell the precipitated sulphate as a white colour instead of the ground mineral sulphate; but no process hitherto suggested can obtain caustic baryta from its sulphate, excepting at a cost greater than that of the whole of the present soda process.

A German chemist, Köbunter, proposed to use carbonate of baryta to decompose a solution of sulphate of soda, but it has been shown that the decomposition is not perfect; when equivalents of carbonate of baryta and sulphate of soda are used, only 75 per cent of the sulphate is decomposed. It has been suggested, to overcome this difficulty of an imperfect reaction, to employ bicarbonate of baryta instead of the simple carbonate, or to force carbonic acid into a mixture of the carbonate with sulphate of soda, and under these circumstances complete decomposition of the sulphate of soda is obtained. I may just mention that when trying the next process in 1865, I tried boiling a mixture of carbonate of baryta with lime, in equivalent proportions, in solution of sulphate of soda under pressure, and obtained a complete decomposition, getting all the soda as caustic without a trace of sulphate: this process does away with the difficulty of obtaining caustic baryta, bnt it is questionable whether the recovery of the carbonate of baryta from the mixture of sulphate of baryta and carbonate of lime would be any cheaper than attempting to recover baryta in the caustic state from the sulphate.

Clausen, in 1852, in one of those sweeping specifications which we occasionally meet with, claims the use of the hydrates of baryta, strontia, and lime, to decompose solutions of sulphate of soda, and heat is said to facilitate the reactions. Singularly enough, lime does decompose a boiling solution of sulphate of soda, but in experiments upon this, I never succeeded in getting more than about 1 per cent of the soda in the sulphate as caustic soda. A. G. Hunter patented an improvement upon this process in 1865. It consisted in heating the mixture of lime and solution of sulphate of soda under pressure, by which he claimed to obtain a better decomposition of the sulphate. Experiments conducted at the Jarrow Chemical Works, showed, however, that the decomposition under these circumstances is still far from complete; with a steam pressure of 40 lbs., only about 6 per cent of the soda was causticised, and even under a pressure of 200 lbs., maintained for some hours, only 13 per cent was obtained as caustic.

The fifth class may be subdivided into three groups.

The first embraces all the processes which have

been suggested to substitute metallic oxides and the other earthy bases for the carbonate of lime in Le Blanc's process. Some of these are of a very early date: furnacing sulphate and coal with lead, tin, or iron was proposed by Higgins in 1781; oxides of manganese, zinc, and copper, as well as the carbonates of baryta and magnesia, have been proposed in later times. The processes of this sort which have been proposed in recent years have aimed at the recovery of the sulphur from the metallic sulphide obtained in the balling process, such as Blythe and Kopp's process of 1854, which was tried a few years ago at one of the Tyne works, only to be abandoned. There is said to be great difficulty in lixiviating the balls from this process, and some tendency to form an insoluble sulphide of iron and sodium. At one time it was a favourite idea to utilise the burnt pyrites from the sulphuric acid process in this way; but, since the introduction of the Spanish and Norwegian cupreous pyrites, oxide of iron is no longer a waste product, the development of the copper-extracting process having found a use for the oxide of iron as a substitute for hæmatite in the puddling process.

With the exception of manganese, the other metals proposed to be substituted are too costly, such as tin, lead, zinc, and copper, and besides they do not present the facility of recovery that iron does, they part less freely with their sulphur, more especially if they get oxidised to sulphate in the process of burning off. Reinar proposed to use the native carbonate of baryta, witherite, in place of carbonate of lime: it is said to have given unsatisfactory results. Hofmann, in his celebrated "Exhibition Report," remarks, about this process, "that it is difficult to see any advantage in substituting, for carbonate of lime, a substance the atomic weight of which is more than three times as great." He appears to be thinking of the atomic weights of calcium and barium when he wrote this, the atomic weight of the carbonate of baryta being scarcely twice that of the carbonate of lime.

Clemm's process, using magnesia or its sulphate instead or carbonate of lime, occupies the border land between the groups of this class. He reduces his mixture in a furnace, casts the product into cylindrical masses, consisting of sulphide of sodium and caustic magnesia. He moistens these, and places them in an atmosphere of carbonic acid, until the magnesia is converted almost into bicarbonate, when he withdraws the cylinders, now consisting of sulphide of sodium and bicarbonate of magnesia, heats them in a stove to about 500°, at which point the bicarbonate of magnesia is entirely decomposed; the carbonic acid at the same time disengaging sulphuretted hydrogen from the sulphide of sodium, so that there is obtained a mixture of carbonate of soda and magnesia, from which the carbonate may be extracted by water. The sulphuretted hydrogen he proposes to convert into sulphuric acid in the ordinary chambers, or to obtain sulphur from it by treatment with sulphurous acid gas and steam.

One of the most interesting features of his process is the means he employs to obtain pure carbonic acid. He passes furnace gases over moistened magnesia, preferably that which has been calcined with soda, which is said to be more active, until the magnesia is for the most part converted into bicarbonate, when he heats the vessel containing it to 500°, which suffices to drive off all the carbonic acid. Clemm's process can, however, have only a local interest for the Stassfurth mines, where so many curious double salts of magnesia and soda are obtained.

The second group of the class contains the processes which prepare sulphide of sodium, with the view of treating its solution with metallic oxides or their carbonates, to obtain a solution of caustic soda or carbonate of soda. It appears to be the general experience of those who have tried to make sulphide of sodium on the large scale, that the product is always more or less contaminated with carbonate of soda; and indeed one of the earliest processes proposed for obtaining carbonate of soda consisted in alternately reducing sulphate and oxidising the sulphide until a considerable quantity of carbonate was formed. The occurrence of this carbonate must therefore operate as a bar to obtaining a strong caustic soda from a solution of the sulphide, by simple treatment with a metallic oxide. The only oxides capable of converting sulphide of sodium into caustic soda, with single equivalents, are the oxides of zinc, lead, and copper; and as the equivalent of zinc is less than a third that of lead, and its price about a third that of copper, it seems to me the only oxide that could be employed in this way. Its use was patented by Hunt in 1840, and its use and very ingenious means for its recovery in connection with the removal of sulphides from ordinary tank liquors, so as to enable caustic soda of the highest marketable strengths to be produced direct from that source, has recently been patented by Parnell. Hunt proposed to obtain sulphate of zinc from the sulphide, and to decompose common salt with it; and I suppose he contemplated the recovery of the oxide by treating the chloride of zinc with lime. The oxides and carbonates of iron and manganese do not decompose the sulphide in equivalent proportions,—an excess has always to be used. In trying to remove the small quantities of sulphide of sodium in tank liquor by carbonate of manganese, I found it necessary to use from ten to twelve equivalents for one of sulphide of sodium.

The treatment of sulphide of sodium by carbonic acid has called forth the utmost ingenuity in contriving apparatus for conducting the process, and in the invention of means to get sulphuric acid or sulphur out of the sulphuretted hydrogen. At the first glance the process appears very attractive; it dispenses with the use of chalk or limestone, does away with tank waste, and offers the inducement of sulphur recovery. But if the sulphuretted hydrogen requires to be converted into sulphuric acid, you require to treat the sulphide with pure carbonic acid, which could not in any case be obtained at the cost of the chalk saved. Great difficulties have been found by those who have tried to convert the sulphuretted hydrogen into sulphuric acid, in obtaining or supplying to the chambers this gas at an equal rate; and for some cause or other there seems to be a difficulty in converting the burnt gas into sulphuric acid in the chambers. The other course open is to use carbonic acid, produced by burning coke in contact with limestone, and get the sulphuretted hydrogen mixed with from 70 to 80 per cent of nitrogen, a state in which it is only fit to be treated by sulphurous acid and steam to obtain sulphur, or to pass over oxide of iron in something like the style of gas purification, or as it has been applied by Gibbs and Gelstharp to precipitate copper. All have failed in making sulphuric acid direct from the sulphuretted hydrogen; the preparation of sulphur has apparently been as hard to deal with; and the roundabout course of absorbing sulphuretted hydrogen by oxide of iron yields a product low in percentage of sulphur, from which the manufacture of sulphuric acid is expensive. The application of this gas to the precipitation of copper from solutions of the sulphate, thus obtaining a dilute sulphuric acid, and the oxidation of the sulphide of copper to the state of sulphate and re-precipitating appear to be of very doubtful value. The cost of fuel for the evaporation of the dilute acid and for furnacing the sulphide of copper would go a long way to pay for the sulphur necessary to make acid from fresh pyrites. The recovery of the sulphur does not present the same inducements in value, now that the use of pyrites has become universal; and it appears to me, that to make the soda process subservient to the recovery of sulphur is unsound in principle; first of all make soda, and then recover the sulphur if it appears worth while: and the best process to my mind is that which yields the sulphur as such. It cannot of course be considered that attempts to obtain caustic soda from the sulphide are anything else than direct soda

processes, the sulphur would be recovered without interfering with the soda process.

There are very few processes in the sixth class which have any interest at the present day; a good many have been proposed to obtain sulphate of soda by double decomposition of common salt with other sulphates. The only processes of this sort worth mentioning here are the decomposition of salt by means of the native sulphates of magnesia and lime, first proposed by Wilson in 1838. The decomposition with sulphate of magnesia may be accomplished by allowing boiling solutions of the salts to cool to near the freezing-point, when nearly all the sulphate of soda crystallises, leaving chloride of magnesium in solution. The sulphate of lime requires to be converted into sulphate of magnesia through the instrumentality of carbonate of magnesia, and the sulphate of magnesia afterwards treated with common salt. These processes have a special interest in consequence of the immense deposits of kieserite and double sulphates of magnesia and soda in the Stassfurth Mines. The process, known as Longmaid's, for obtaining sulphate of soda by roasting pyrites with salt, was known 50 years before the date of his patent in 1842, and is said to have been practised in France at that time. The decomposition of the salt has never been obtained complete by it unless the pyrites is considerably in excess of that required by theory. In 1853, Robb proposed to obtain sulphate by passing sulphurous acid, air, and steam, over a mixture of common salt and oxide of iron. Brooman, in 1857, dispensed with the oxide of iron, and passed the gases over common salt contained in hot flues; and Hargreaves, in 1872, mixes the common salt with sufficient water, and moulds it into bricks, for treatment with sulphurous acid, air, and steam, in hot chambers, The tediousness of the converting process, and the inevitable loss of a considerable quantity of sulphurous gas, are obstacles at present to the application of this process; it is however a most interesting one, and seems to have been gradually developing since Longmaid's time.

I would have liked to have gone into some of these processes more fully, and especially those in which the reactions are of an imperfect or limited character, as the study of the conditions under which they take place and the conditions which modify the results obtained are of great interest to the chemist, but fearing to be tedious I have left out much that I might have said on this score, and perhaps this may form the substance of a future paper on limited reactions.

METALLURGICAL SCIENCE.*

It is with a feeling somewhat akin to shame that we are bound to acknowledge the poverty of our language in metallurgical literature. The entire catalogue of English works on metallurgy may be told off in two minutes upon one's fingers, and several even of these are at present too rare to be generally accessible, or too antiquated to be practically useful. Percy's masterly work, though commenced more than a dozen years ago, is at present nothing more than a splendid fragment; while two out of the three volumes which have been issued are already out of print. Phillips's Manual, excellent in its day, is well nigh useless at the present time; and the same remark applies with even greater force to several other works which were at one time standards of reference. It is true that we can boast of several capital volumes on special branches of metallurgy—Phillips's "Gold and Silver," to wit; but the fact remains that we can point to only a single modern treatise which comprehensively treats of the entire range of metallurgical operations: that treatise we need hardly say is the recent adaptation of Kerl's celebrated "Handbuch."† But these three handsome volumes, though not a whit too bulky for the matter they contain, are appalling to the student who does not wish to dip deep into the subject; and it must therefore be confessed that a trustworthy moderate-sized text-book of home growth has long been a real want to the student. Mr. Makins has sought to supply this want, and though his "Manual" is a long way from satisfying us, there is no doubt that for its size, it is the best that we at present possess.

As those who are familiar with the former edition of this work may have been led to view it somewhat unfavourably, it is only fair to mention at the outset that the present edition has been re-written, considerably enlarged, and in every way improved. The modern atomic weights are employed throughout, the chemical nomenclature is quite up to date, not to say a little pedantic in a practical book, and degrees of temperature are expressed on both the Fahrenheit and Centigrade scales. The arrangement followed in the classification and description of the metals is to our notion somewhat fanciful. The so-called "noble metals," mercury, silver, gold, platinum, and palladium, are taken first; and the "base metals" are then dealt with in the following order:—Lead, bismuth, copper, antimony, uranium, titanium, chromium, arsenic, iron and steel, manganese, cobalt, nickel, tin, zinc, cadmium, aluminium, magnesium, potassium, and sodium. It also occurs to us that the space is very disproportionately distributed among these metals; for example, silver occupies 70 pages, and gold takes exactly the same space, whilst copper, in spite of its high importance and the complexity of its metallurgical treatment, receives only 32 pages, and iron and steel *together* are condensed into 65 pages.

It is pleasing to note that, in many parts of his work, Mr. Makins shows himself to be fairly abreast of his subject. He offers us, for example, fair descriptions of Miller's process for toughening brittle gold by means of chlorine; of Siemens's regenerative furnaces, his method of steel-making, and his electrical pyrometer. On the other hand, we may light upon parts of the book which are certainly behind the day. Nowhere is this more conspicuous than in the chapter on iron and steel. Here we look in vain for any notice of Mr. Lowthian Bell's important researches on the blast-furnace, though surely these researches must be known to anyone who is writing on the theory of iron smelting. But it is yet more curious that in a work published in 1873, with an appendix, too, for the latest novelties, there is no mention of Danks's rotatory furnace, or, indeed, of any furnace for mechanical puddling. It is scarcely too bold to say that the days of manual puddling are numbered, and one of the most interesting problems at present engaging the attention of the ironmaster is the best means of substituting machinery for this exhausting and time-consuming labour.

Comparing one part of Mr. Makins's book with another, it is clear that the most satisfactory chapters are those on silver and gold; and, as might be expected from the author's former position, we find him at his best when describing the methods of assaying these two metals.

In a hasty perusal of this "Manual," we have stumbled on a considerable number of errors. It may be charitable to father some of these upon the printer, but others are of a graver character, and clearly betray the unpleasant fact that the author is not always master of his subject. At the same time, we willingly admit that the book has merits which are neither few nor small, and we repea t that, in the present state of our metallurgical literature, we know of no handier manual than that of Mr. Makins's. Every page may not smell of the furnace, but the volume as a whole is evidently the work of an honest and painstaking compiler.

* "A Manual of Metallurgy." By George Hogarth Makins, M.R.C.S., F.C.S., &c. Second edition; re-written and much enlarged. London: Ellis and White. 1873.

† "A Practical Treatise on Metallurgy." Adapted from the last German edition of Professor Kerl's "Metallurgy." London: Longmans and Co.

CORRESPONDENCE.

MANUFACTURE OF CHLORINE.

To the Editor of the Chemical News.

Sir,—With reference to a passage in my Inaugural Address, reprinted in your last issue, Mr. Walter Weldon requests me to state that now more than half the chlorine made in Great Britain is made by his process, and that nearly a score new plants are in course of construction.

I gladly comply with Mr. Weldon's request, although I am sure that the whole context of the passage in question totally excludes the idea of any disparagement being meant to the processes referred to.—I am, &c.,

George Lunge.

MISCELLANEOUS.

London International Exhibition, 1873.—A meeting of the Sub-Committees on Surgical Instruments and Appliances was held in the West Theatre, Royal Albert Hall, on Monday, the 24th ult. The following members were present:—Sir Wm. Fergusson, Bart., F.R.S.; Mr. W. White Cooper; Mr. H. J. Domville, C.B., M.D.; Mr. J. Hilton, F.R.S.; Mr. R. Liebreich; Prof. J. Marshall, F.R.S.; Mr. A. E. Mackay, M.D.; Mr. T. W. Nunn; Dr. W. S. Playfair. The committees inspected the various objects which have been submitted on exhibition.

Preserving Charred Papers.—Mr. E. H. Hoskins, of Lowell, Mass., has suggested a very useful and practical way of preserving and giving toughness and flexibility to charred paper, which has proved to be of much importance in the identification and copying of valuable documents, charred by conflagrations such as the recent Boston and Chicago calamities. We have seen specimens of charred papers and bank-notes, thus treated, that can be handled with impunity. The printing upon the charred bank-notes can be readily discerned. The preserving process consists, we believe, in pouring collodion upon the surface of the charred paper. The collodion forms a thin transparent film, dries in a few minutes, when the process is complete.—*Scientific American.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, March 24, 1873.

In addition to a large number of original papers and memoirs relating to various other branches of the exact sciences, this number contains the following original papers and essays relating to chemistry:—

Constitution of the Hydracids when in Solution, and on the Inverse Reactions which they call forth.—Dr. Berthelot.—This essay is the continuation of that alluded to in the preceding number of this periodical. In this portion the author records his extensive investigation on the constitution of the hydracids dissolved in water. These solutions differ greatly; in the more dilute solutions various hydrates are present, while in the concentrated solutions, hydrates with 1 equivalent of acid, and even anhydrous acid, are present. There appears to be a marked difference between the chemical properties of the anhydrous acids and their hydrates, while the thermical properties also vary.

Researches on New Derivatives of Propyl.—A. Cahours.—This exhaustive monograph, elucidated by a large number of formulæ, treats on the organo-metallic alcohol compounds of the propyl series, and more particularly on the zinc, aluminium, and arsenic combinations with the organic bodies alluded to.

Thermo-Chemical Researches on the Measurement of the Chemical Action of the Sun's Rays.—E. Marchaud.

Volumetrical Estimation of Carbonic Acid.—A. Houzeau.—The author briefly describes a process consisting first in the absorption of the carbonic acid by a solution of caustic soda, whereto oxide of zinc is added. Next, to the carbonate thus produced chloride of barium is added, and the soda—not previously combined with carbonic acid—is estimated volumetrically by titrated sulphuric acid.

Researches on Trichloracetic Acid and Trichloracetates.—A. Clermont.—This paper treats mainly on the trichloracetates of mercury, and is elucidated by a large number of formulæ and results of analyses.

Researches on the Ripening of Fruit and on Endosmose of Leaves and Roots of Plants.—J. Boussingault.—An exhaustive phyto-chemical essay.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 4, 1873.

Contains the following original papers and memoirs:—

Selenic Acid and Selenates.—Dr. von Gerichten.—The selenic acid is best prepared by first oxidising the selenium with nitric acid and converting it into selenious acid. Potassa is next added to the solution and chlorine passed through it so as to obtain selenic acid; the product is then combined with baryta. By double decomposition the salt thus formed is, with the aid of a slight excess of carbonate of potassa, converted into a selenate of the last-named base. The mixture of (for, as pointed out by H. Rose, see Fresenius *Zeitsch*, vol. i., 73, the decomposition alluded to is not quite complete) carbonate and selenate of potassa is, in order to neutralise the former, treated first with nitric acid, and next with a soluble lead salt, the selenate of lead is lastly decomposed by sulphuretted hydrogen. The selenates are, it is well known, generally isomorphous with the sulphates, chromates, and manganates. This paper also treats on the composition of the double alums of selenic and sulphuric acid, and is accompanied with a series of lengthy and complex formulæ, of which the following is quoted as an instance:—

$$\left.\begin{matrix} SO_2 \\ \\ \\ SeO_2 \end{matrix}\right\} \begin{matrix} \left.\begin{matrix} O \\ O \\ O \end{matrix}\right\} Al.Cr \\ \\ \left.\begin{matrix} O \\ O \end{matrix}\right\} K.NH_4 \end{matrix} + 12H_2O$$

Chemical Composition of the Eggs of Serpents.—Dr. Hilger.—The eggs of the *Coluber natrix*, an indigenous reptile of Central Europe, were investigated by the author. The shell contains carbonate and phosphate of lime, and traces of silica, iron, and sulphate of lime. (The author observes that this compound is more frequently met with as a constituent of the bodies of the lower orders of the animal kingdom, such as the skin of a Holothuria species, and also the tunica of *Pyrosoma ind.*, &c.) The yolk of the eggs contains an albumenoid matter akin to myosin; further, lecithin, cholesterine, alkali-albuminate, ordinary albumen; and as mineral matter, phosphates, chlorides and sulphates of alkalies. In addition to these substances the yolk as well as the shell was found to contain a peculiar organic matter, rich in nitrogen, but quite free from sulphur and phosphorus. This organic matter in the dry state is a yellowish horny mass, which swells up in water, and is insoluble in alcohol, ether, acetic and dilute hydrochloric acids, while it resists the action of concentrated caustic potassa for several months. Its percentical composition is—Carbon, 54·68; hydrogen, 7·24; nitrogen, 16·37; oxygen, 21·10. These figures closely resemble the composition of elastin, but the author intends to investigate this subject further.

On Phenanthren and Anthracen.—R. Fittig.—The contents of this paper, elucidated by a large number of complex formulæ, treat more particularly on the keton formation from anthracen and phenanthren.

Researches on Phenols.—H. Hübner and O. Brenker.—This monograph is divided into the following sections:—Preparation of monobromphenol, C_6H_4BrOH, from β-bromsalicylic acid by dry distillation; preparation of monobromphenol from crystallised phenol and bromine; preparation of chloro-salicylic acid, $C_6H_3ClOHCOOH$, by the action of chlorine upon salicylic acid.

Conversion of Benzoic into Metachlororthoxy-benzoic Acid.—H. Hübner and G. Weiss.—7 grms. of benzoic acid, 4 grms. of manganese (peroxide, previously washed with hydrochloric acid), 40 grms. of concentrated hydrochloric acid are heated to 150° in a sealed glass tube, and after a repeated re-crystallisation of the contents, there is obtained pure metachlor-benzoic acid, the baryta salt of which,—

$$(C_6H_3.Cl.H.COO)_2Ba,$$

crystallises in long needle-shaped crystals. By treating the acid with fuming nitric acid there is formed metachlorortho-nitrobenzoic acid, $C_6H_3.Cl.NO_2.COOH$. This body, on being treated with tin and hydrochloric acid, yields metachlorortho-amidobenzoic acid—

$$C_6H_3.Cl.NH_2.COOH.$$

a crystalline amido acid fusing at 148°. The metachlorortho-benzoic acid is formed by the previously-mentioned acid being treated at 50°, and dispersed through water with nitrous acid.

Action of Benzoic Acid on Phenyl-Mustard Oil (Phenyl-senföl).—S. M. Losanitch.

Some Iodine Substitution Products.—P. Weselsky.

Formation and Decomposition of Ketons.—W. Staedel.

A New Species of Lime-Precipitating Plant.—F. Wibel and Zacharias.—This paper treats mainly on the peculiar property of a potamogeton species of separating lime from water in which it is dissolved.

Pseudomorphoses of Glass and Gypsum due to the Action of Cranberries.—F. Wibel.—It appears that the sample of the fruit alluded to had been kept in a glass bottle for some time, and the acid (chiefly malic) contained in the berries had decomposed the soda-glass, thereby giving rise to the formation of a compound which, on analysis, was found to contain—Water, 4·96 per cent; organic matter, 5·29; gypsum, 56·83; glass, 32·92; total, 100·00.

Analysis of Waters from the Ionian Islands.—F. Wibel.—From among the large number of results of analyses here quoted, we mention the more interesting:—Cape Hugios Georgios (St. George), Peninsuly Lexuri; sp. gr. of the water 1029·78; constituents in 1 litre—Chloride of sodium 31·68, sulphate of lime 1·96, sulphate of magnesia 2·09, chloride of magnesium 3·43. Water from Argostoli; sp. gr. 1023·96; chloride of sodium 32·22, gypsum 1·77, sulphate of magnesia 2·33, chlormagnesium 3·75. The other waters are either brackish or fresh water, but their composition is chiefly of local interest.

Fibrous Quartz of South Africa.—F. Wibel.—After first referring to Klaproth's researches (1815) on this subject, the author quotes the following results of analysis:—Brown-coloured fibrous quartz, sp. gr. at 15°=3·05; composition—SiO_2, 57·46; Fe_2O_3, 37·56; H_2O, 5·15. Blue-coloured fibrous quartz, sp. gr. at 15°=2·69; composition—SiO_2, 97·27; FeO, 1·67; CaO, 0·15; Na_2O, 0·15; H_2O, 0·76.

New Hydrocarbon Obtained from Diphenyl-keton.—R. Fittig.

On Graphite.—C. Rammelsberg.—The main contents of this lecture, elucidated by the exhibition of specimens, may be summarised as follows:—History of graphite in its geologico-geognostic bearing; loss by ignition, amounting in the following samples—Ticonderonga (N.Y.), 3·85 per cent; Ceylon, 2·56; Borrowdale, 3·8 to 5·08; Upper Jenisei (Siberia), 2·53; Tunguska (Sidorow), 1·77 to 2·38. The quantity of earthy matter in these samples is respectively—Ceylon, 1·28 per cent; Borrowdale, 7·0; Upper Jenisei, 4·5: Tunguska, 6·53. Comparison between the combustibility of graphite and diamond, as well as other amorphous carbon species. Some kinds of graphite burn completely off, others do not, when in contact with fused saltpetre; among the former the author quotes—Ceylon, sp. gr. 2·257; Borrowdale, 2·286; Upper Jenisei, 2·275; Upernivik, (Greenland), 2·298; Arendal, 2·321. To the non-burning off belong—Ticonderonga, sp. gr. 2·17; Ceylon (other sample marked II.), 2·246; blast-furnace graphite, 2·30.

Preliminary Notice on the Decomposition of the Ketons.—Dr. W. Haedel.

On Lead; the Impurities it may Contain, and the Influence thereof upon the Industrial Applications of this Metal.—G. Brigel. Reserved for translation.

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C., and 8, Houndgate, Darlington.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

650. M. Henry, Fleet Street, London, "Improvements in the mode of, and apparatus for, treating marine plants, called sea-weed, sea-wrack, and algæ, in order to obtain useful products therefrom for industrial and other purposes."—A communication from the Société Collett et de Lavillase, Landernau, France.—Petition recorded February 20, 1873.

752. J. Buchanan, Hebburn, Durham, "Improvements in utilising alkali waste in the manufacture or production of building materials."—Petition recorded March 1, 1873.

809. L. O. Durruthy and H. P. Lissagarary, Rue des Petits Hotels, Paris, "Improvements in the treatment of blood for the manufacture of manure."

819. A. P. Vassard, New Cross, Kent, "Improvements in the manufacture of artificial fuel, and in the solidifying of coal-dust and other substances by agglomeration."—Petitions recorded March 6, 1873.

823. W. Wright, Sheffield, Yorkshire, "Improvements in the manufacture of gas for heating and illuminating purposes, and in apparatus for the same, parts of which are applicable to other purposes."—Petition recorded March 7, 1873.

834. J. Keene, Bush Lane, Cannon Street, London, "A new or improved amalgam for the better imitation of silver."—A communication from Madame P. Baudoin, Rue des Marais, Paris.

841. J. Wadsworth, Manchester, "Improvements in utilising refuse matter for the manufacture of fuel and manure."

847. F. Kuhlmann, Paris, "New utilisations of the acid residues resulting from the manufacture of chlorine."—Petitions recorded March 8, 1873.

854. E. Galeer, Bienne, Berne, Switzerland, "An improved hair-wash."—Petition recorded March 10, 1873.

863. H. Page, Mincing Lane, London, "Improvements in the manufacture of paper-pulp or half-stuff."

868. W. Weldon, Putney, Surrey, "Improvements relating to the manufacture of chlorine by means of compounds of manganese regenerated in the wet way."—Petition recorded March 11, 1873.

891. J. Jones, Great Lever, Lancashire "Improved combinations of substances or materials to be used as a substitute for coal for obtaining heat and light, and in the arrangement of the furnaces or fire-places connected therewith."

894. R. J. Jones, Walton, near Liverpool, "Improvements in operations and apparatus for drying-down waste alkaline solutions of extractive matter obtained in preparing vegetable fibrous material for use in the manufacture of paper, and in recovering therefrom the alkali for re-use, also for utilising the vapours given off during the boiling of the vegetable material or the drying-down of the said solutions."

896. S. B. Darwin, Shrewsbury, Salop, "Improvements in the means of manufacturing gas."—Petitions recorded March 12, 1873.

INVENTION PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

980. G. T. Bousfield, Sutton, Surrey, "Improvements in the manufacture of cheese."—A communication from H. O. Freeman, Sherburne, New York, U.S.A.—Petition recorded March 17, 1873.

NOTICES TO PROCEED.

3278. W. Glazier, Rochdale, Lancashire, "Improvements in treating and utilising certain refuse animal and vegetable substances, and the application of the resulting substances or matters to various manufactures."—Petition recorded November 5, 1872.

3288. H. Harrison, Killenaule, Tipperary, Ireland, "Improvements in the manufacture of artificial or prepared fuel from anthracite dust o 'culm,' or from other coal dust, and in apparatus employed in such manufacture.—Petition recorded November 6, 1872.

3300. G. H. C. Hedley, W. Smith, and T. A. Hedley, Salisbury Street, Strand, London, "Improvements in the manufacture and purification of gas, and in the apparatus employed therein and connected therewith."—Petition recorded November 7, 1872.

3335. C. de Sainte Marie, Porte Ste. Marie, France, "An improved process of tanning hides and skins."—Petition recorded November 9, 1872.

3460. A. Morgan, South Lambeth Road, Surrey, "An improved method for purifying and amalgamating gum resins, including Kauri gum."—Petition recorded November 20, 1872.

645. J. Webster, Birmingham, "Improvements in applying gases or vapour to the refining and purifying of metals, and in apparatus to be employed for that purpose."—Petition recorded February 20, 1873.

736. R. Jukes, Sheffield, Yorkshire, "Certain improvements in the construction of reverberating-furnaces or cupolas, and in the processes connected therewith for the purpose of smelting."—Petition recorded February 27, 1873.

803. W. Mickle, Tynemouth, Northumberland, "Improvements in smelting and puddling iron."—Petition recorded March 5, 1873.

PATENTS SEALED.

2822. C. Morfit, Baltimore, Ma., U.S.A., "Improvements in the reclamation of materials employed in the manufacture of diphosphate and triphosphate of lime."—Dated September 24, 1872.

3014. S. H. Johnson, F.C.S., Stratford, Essex, "Improvements in the method of, and apparatus for, separating the soluble constituents of substances from the insoluble constituents."—Dated October 12, 1872.

3067. W. Morgan-Brown, Southampton Buildings, London, "An improved composition for preserving wood, metal, stone, brick, paper, textile and felted fabrics, cordage, and cables."—A communication from F. O. Möller, Rue Lavoisier, Paris."—Dated October 17, 1872.

3505. R. F. L. Jenner, Kidwelly, South Wales, "Improvements in the manufacture of dinas fire-bricks."—Dated November 23, 1872.

3737. W. R. Lake, Southampton Buildings, London, "An improved method of clarifying and settling varnishes, oils, and other like substances."—A communication from F. Kersting, Grand Rapids, Mich., U.S.A.—Dated December 9, 1872.

3924. W. McAdam, Glasgow, N.B., "Improvements in utilising waste-products of chemical and other works in order to render the same applicable for building and structural purposes."—Dated December 27, 1872.

3970. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "New or improved methods, processes, and apparatus for depositing upon wrought-iron, steel, and cast-iron, layers of copper or alloys of copper."—A communication from O. Gauduin, J. B. J. Mignon, and S. H. Ronart, Paris.—Dated December 31, 1872.

213. G. Haseltine, LL.D., Southampton Buildings, London, "Improvements in the manufacture of white-lead, and in the purification of carbonic acid gas used in the said manufacture, and in apparatus therefor."—A communication from A. P. Meylert, New Britain, Conn., U.S.A.—Dated January 18, 1873.

268. H. Williams, Wigan, Lancashire, "Improvements in the utilisation of the waste heat from coke ovens for the manufacture of soda-ash, caustic soda, and for other similar purposes."

273. R. Pitt, Bath, and S. F. Cox, Bristol, "Improvements in the manufacture of leather, and in apparatus for that purpose."—Dated January 23, 1873.

331. B. Latham, Victoria Street, Westminster, "Improvements in purifying sewage, and treating products obtained therefrom for the production of manure."—Dated January 28, 1873.

NOTES AND QUERIES.

Tin Ore.—Is there any shorter and easier analytical test for tin ore than that given in Fresenius?—J. W.

Bichromate of Zinc.—Can any of your readers inform me how bichromate of zinc is made? I imagine, from the few experiments I have made, that it must be a somewhat tedious process.—A SUBSCRIBER.

Sesqui-Acetate of Ammonia.—Will your readers inform me as to the best method of making sesqui-acetate of alumina (commercial red liquor) from acetate of lime liquor, stating proportionate quantities and strengths of decomposing bodies?—H. T. C.

Sulphate of Ammonia.—Can you, or any of your subscribers, inform me, through your journal, the quantity of sulphate of ammonia that can be made from a gallon of gas liquor for each degree of sp. gr. by Twaddell's hydrometer?—C. H. N.

Ponceau.—(Reply to S. and H.)—Consult the work of Girard and De Laire, lately reviewed in these columns.

Bunsen Burner.—(Reply to E. R.)—There is no such formula. The matter is easily solved by a good and steady pressure of gas: but in many localities, in as well as out of the Metropolis, the pressure of the gas as usually supplied is far too weak for the purpose.

Ammonium Sulphate.—(Reply to W. B. Giles.)—Concentrate over an open fire in a shallow leaden pan supported by iron, and run the very concentrated fluid off in shallow wooden tanks lined with lead. On cooling, the sulphate will crystallise. Run off the mother-liquor, and again saturate this with ammonia. Of course, on boiling down, some of the latter is volatilised, and an acid liquid results. Try the proper degree of concentration, by taking a sample and cooling it; if it yields crystals, or at any rate a solid saline deposit, run off the fluid into the coolers.—A. T.

"Acoustic Repulsion and Attraction," by R. H. Schellbach, *Phil. Mag.*, 1871, vol. xli., p. 418:—

"If the action exerted upon one another by atoms at exceedingly small distances be admitted as comprehensible, we must be prepared to admit the extension of the attractive or repulsive force to masses at very great distances from one another. The distant action of magnetism and electricity would then require no special explanation, and is not necessarily a consequence of the interposition of a connecting medium. Nevertheless it is possible that phenomena of attraction or repulsion at considerable distances might be occasioned by oscillations of æther or air."

P. 422.—"The sonorous vibrations of an elastic medium attract specifically heavier bodies to the centre of disturbance, and repel specifically lighter ones."

"Approach Caused by Vibration," by Sir W. Thomson, *Phil. Mag.*, 1871, vol. xli., p. 423:—

"The average pressure at any point of an incompressible frictionless fluid originally at rest, but set in motion and kept in motion by solids moving to and fro, or whirling round in any manner, through a finite space of it, is equal to a constant diminished by the product of the density into half the square of the velocity."

P. 426.—"The repulsion of a hydrogen balloon observed by Schellbach is temptingly suggestive of the conclusion he has drawn, that there is attraction or repulsion accordingly as the density of the interior gas is greater or less than that of the surroundingair."

MEETINGS FOR THE WEEK.

MONDAY, April 7th.—Medical, 8.
—— London Institution, 4.
TUESDAY, 8th.—Civil Engineers, 8.
—— Photographic, 8.
WEDNESDAY, 9th.—Geological, 8.

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SUPPLEMENT
TO
THE CHEMICAL NEWS.
VOL. XXVII. No. 697.

ON METHYL-ALIZARINE AND ETHYL-ALIZARINE.*

By EDWARD SCHUNCK, Ph.D., F.R.S.

IN a paper which I had the honour of reading before this Society some time ago,† I gave an account of a yellow colouring matter accompanying artificial alizarine, to which I gave the name of *anthraflavic acid*. Though the substance was at the time new to me, and apparently to others also, it is quite possible it may have been previously observed by those working with artificial alizarine, since the crude product is probably hardly ever quite free from it, and its presence would not be likely to escape the notice of anyone endeavouring to prepare pure alizarine from the manufactured article.

My analysis of the acid, and of its barium and silver salts, led to the formula $C_{15}H_{10}O_4$ for the acid, and I was therefore inclined to view it as a body homologous with alizarine, or alizarine in which H is replaced by CH_3. I supposed it to be derived from a hydrocarbon higher in the series than anthracene ($C_{15}H_{12}$?) contained in the ordinary anthracene of commerce, a body which is supposed by some chemists really to exist, and which would stand in the same relation to anthracene as toluol does to benzol. It was necessary to adopt some such hypothesis, since, as Græbe and Liebermann remark, in referring to my experiments, a compound obtained from anthraquinone by the same process as that yielding alizarine cannot possibly contain 15 atoms of carbon. The conversion of the acid into alizarine by the action of fusing caustic potash would, however, admit of explanation in accordance with my view, since the methyl presumed to be contained in it might be supposed to be eliminated and replaced by hydrogen during the process.

The examination of anthraflavic acid was subsequently undertaken by Mr. Perkin,‡ whose analysis of the carefully purified substance led to the conclusion that it is isomeric with alizarine. I do not wish to dispute the accuracy of this view of its composition, since a trifling admixture of some impurity, such as anthraquinone, might easily have given rise to the excess of carbon found in my analysis, though I may state that a specimen of the substance, prepared from some of the "by-product" of the manufacture of alizarine—kindly sent me by Mr. Perkin—and purified with great care, gave exactly the same composition as before.

Græbe and Liebermann ‖ have also examined a yellow crystalline body accompanying artificial alizarine, which is converted into the latter by the action of fusing caustic potash. They are of opinion that it is identical with anthraflavic acid, there being, indeed, little or no difference in the properties of the two substances. They assign to it the formula $C_{14}H_8O_3$, and consider it as monoxyanthraquinone, alizarine being dioxyanthraquinone. The results of their analysis of the substance and its barium compound differ however so widely from those obtained by Mr. Perkin and myself (particularly in this respect, that in the compounds of anthraflavic acid two atoms of hydrogen are replaced by metals, whereas in those of monoxyanthraquinone only one atom is replaced) as to lead to the conclusion either that there exists more than one body having the general properties—chemical and physical—of anthraflavic acid, or that we have not all of us been working with pure substances.

Without pronouncing any decided opinion on this point, which can only be determined by further investigation, and without entertaining any sanguine anticipation of being able to prepare anthraflavic acid directly from alizarine, it seemed to me that it might be of some interest to ascertain the nature and properties of the methylic and ethylic substitution products of alizarine obtained directly from the latter.

In order to obtain methyl-alizarine, I tried several methods. The first consisted in heating bromalizarine with iodide of methyl and metallic silver in closed tubes. This process yielded a small quantity of a crystalline substance, which I believed to be the compound sought for. The other method, which is one now often practised for obtaining methylic and ethylic substitution products, gave better results. Purified artificial alizarine was treated with a mixture of iodide of methyl, caustic potash, and a little methylic alcohol in closed tubes, at a moderate temperature. After heating for some days, the tubes were opened and emptied, and the excess of iodide of methyl having been evaporated, the residue was treated first with hot water, to remove the iodide of potassium, and then with a little cold alcohol. The alcohol—which dissolved out a brown resinous impurity—having been filtered off, the residue was treated with dilute caustic potash lye, in which the alizarine not acted on dissolved with a violet colour. The liquid having been filtered off, the residue, which consisted of the potassium compound of methyl-alizarine—a compound very little soluble in cold water—was washed until the percolating liquid began to be of a cherry-red colour. It was then treated with hydrochloric acid, and the orange-coloured flocks left undissolved were filtered off, washed, and dissolved in boiling alcohol. The alcohol, on cooling, deposited cystalline needles of methyl-alizarine.

Methyl-alizarine as thus prepared has the following properties :—When crystallised from boiling alcohol it appears in long yellow needles, having a reddish tinge, but without the semi-metallic lustre peculiar to alizarine which it generally resembles. When heated it is entirely volatilised, yielding a sublimate of yellow lustrous scales and needles. It is almost insoluble in boiling water, but dissolves easily in concentrated sulphuric acid, even in the cold, giving a cherry-red solution. It does not dissolve sensibly in caustic potash lye in the cold, but on boiling a bright cherry-red solution is obtained, which on cooling deposits dark red crystalline masses. The solution shows no trace of absorption-bands, but only a general obscuration of the green part of the spectrum, and in this respect differs widely from the alkaline solutions of alizarine, which exhibit such very characteristic absorption-bands. The solution in concentrated sulphuric acid does, however, show an absorption-band on the border of the green and blue, just like a solution of anthraflavic acid in the same menstruum, but far less distinctly than the latter, on account of the much greater obscuration of the parts of the spectrum adjacent to the band. On adding alcoholic potash solution to an alcoholic solution of methyl-alizarine the potassium compound is deposited in dark red needles, arranged in star-shaped masses. The sodium compound, prepared in the same way, crystallises in small light red needles. A watery solution of the potassium compound gives with chloride of barium a red flocculent precipitate. The alcoholic solution of methyl-alizarine gives no precipitate with acetate of lead. When treated with boiling nitric acid methyl-alizarine is dissolved and decomposed, and the solution on evaporation leaves a white crystalline residue, probably of phthalic acid. Methyl-alizarine undergoes no change when treated with strong caustic potash

* Read before the Manchester Literary and Philosophical Society, March 18, 1873.
† *Proceedings Lit. and Phil. Soc.*, Session 1870-71.
‡ *Chem. Soc. J.*, xxiv., 1109.
‖ *Liebig's Annalen*, clx., 141.

lye, even at the boiling temperature. It is only when fusing hydrate of potash is employed that decomposition takes place. If the operation be carefully conducted there is obtained, on the addition of water to the fused mass, a violet-coloured solution, which shows the absorption-bands of alizarine very distinctly. There is no doubt, therefore, that by the more energetic action of the alkali at the temperature of fusion alizarine is regenerated. Methyl-alizarine does not dye mordanted cloth when tried in the usual manner. It imparts hardly any colour to the mordants, and differs, therefore, in this respect from the parent substance more than in any other.

Though methyl-alizarine differs in most points very widely from anthraflavic acid, still the two substances are found to resemble one another as regards some of their properties. Both yield crystallised potassium and sodium compounds. Both are converted into alizarine by the action of fusing potassic hydrate, though both remain unchanged when treated with strong alkaline lyes. The action of both on the spectrum is very similar. Neither of them is precipitated from its alcoholic solution by acetate of lead. Both are incapable of dyeing mordants.

The analysis of methyl-alizarine gave numbers corresponding with the formula $C_{15}H_{10}O_4$. It is therefore alizarine in which one atom of hydrogen is replaced by methyl. It still remained to determine how this substitution takes place, whether it is one of the two hydroxyl atoms contained in alizarine the hydrogen of which is replaced by methyl, or whether the substitution is effected in a different manner. In the former case methyl-alizarine would contain only one atom of hydrogen replaceable by metals. The formula of methyl-alizarine being $C_{14}H_6(HO)(CH_3O)O_2$, that of the potassium compound, for instance, would be $C_{14}H_6(KO)(CH_3O)O_2$ and it would contain by calculation 13·3 per cent of potassium. Now the potassium compound prepared in the manner just described and dried first over sulphuric acid and then at 130° C., was found to contain 12·6 per cent of potassium. It is certain therefore that methyl-alizarine belongs to the class of compound ethers, being formed by the replacement of one of the hydrogen atoms of a bibasic acid by methyl. It has a similar composition to Mr. Perkin's diacetyl-alizarine. In the latter, however, two atoms of hydrogen are replaced by the compound radical acetyl. Diacetyl-alizarine seems also to be a much less stable body than methyl-alizarine.

Ethyl-alizarine may be prepared in the same way as the corresponding methyl compound, employing iodide of ethyl in place of iodide of methyl. The properties of the two substances are so nearly alike that they can hardly be distinguished from one another. The composition of ethyl-alizarine is expressed by the formula $C_{16}H_{12}O_4$.

Specimens of the two substances were shown along with some specimens sent for exhibition by Mr. Perkin, including the new colouring matter lately discovered by him, anthrapurpurine, and samples of dyed calico showing the different effects produced by alizarine and anthrapurpurine.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Anniversary Meeting, Monday, March 31st, 1873.

Professor Frankland, D.C.L., F.R.S., President, in the Chair.

The President, in his address on this, their thirty-second anniversary, congratulated the Society on its prosperous state, and the large increase of members it had received during the past year. The members being 624 in March, 1872, 76 had since been admitted, and it had lost 18; so that the numbers were now 682, exclusive of the 32 foreign members. The names of the 10 members who were deceased since the last anniversary were T. Bloxam, John Cargill Brough, Ernest Theophron Chapman, John Hunter, Henry Beaumont Leeson, F. Muspratt, Robert Rumney, Benjamin Charles Staples, Thomas Thomas, and J. Chapman Wilson. The President also noticed the very large number of original communications which had been read at the Society's meetings during the past year, fifty-eight in number, being greater than that received during any similar period since the foundation of the Society, remarking, however, that although it was extremely gratifying to find that we had made such progress in original research, we were still far from occupying the position we ought to do. This he believed was chiefly owing to the attitude which the universities assumed towards the prosecution of original investigation.

After the Treasurer had made his financial statement, which was satisfactory, showing a considerable increase in the balance in hand, the Secretary read the bye-law relating to the election of officers and council, who were then balloted for.

The following are the names of the gentlemen elected:—

President.—W. Odling, M.B., F.R.S.

Vice-Presidents who have filled the office of President.—Sir B. C. Brodie, F.R.S.; Warren De la Rue, Ph.D., F.R.S.; E. Frankland, D.C.L., F.R.S.; A. W. Hofmann, D.C.L., F.R.S.; Lyon Playfair, Ph.D., C.B., F.R.S.; A. W. Williamson, Ph.D., F.R.S.; Colonel P. Yorke, F.R.S.

Vice-Presidents.—H. Debus, Ph.D., F.R.S.; A. Vernon Harcourt, M.A., F.R.S.; H. E. Roscoe, Ph.D., F.R.S. Maxwell Simpson, Ph.D., F.R.S.; J. Stenhouse, Ph.D., F.R.S.; A. Voelcker, Ph.D., F.R.S.

Secretaries.—W. H. Perkin, F.R.S.; W. J. Russell, Ph.D., F.R.S.

Foreign Secretary.—H. Müller, Ph.D., F.R.S.

Treasurer.—F. A. Abel, F.R.S.

Members of Council.—H. E. Armstrong, Ph.D.; A. Crum Brown, D.Sc.; Dugald Campbell; E. Divers, M.D.; B. F. Duppa, F.R.S.; A. Dupré, Ph.D.; G. C. Foster, F.R.S.; M. Foster, M.D., F.R.S.; H. McLeod; Peter Spence; Hermann Sprengel, Ph.D.; Thomas Stevenson, M.D.

The usual votes of thanks were then proposed. Dr. Williamson proposed the vote of thanks to the President, which was seconded by Professor Heaton. Mr. Warington proposed the Officers and Council, especially mentioning the senior Secretary, Mr. Vernon Harcourt, who has resigned his office; this was seconded by Dr. Armstrong. Professor Abel proposed the Auditors, seconded by Professor Foster. Mr. Bassett, the Editor and Abstractors, seconded by Dr. Debus.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, March 4th, 1873.

J. P. Joule, D.C.L., LL.D., F.R.S., &c., President, in the Chair.

Mr. Francis Nicholson, F.Z.S., was elected an Ordinary Member of the Society.

Mr. Baxendell read the following communication from Mr. S. Broughton:—

It appears there is some doubt as to the existence of ball discharge in thunderstorms. At the request of Mr. Baxendell I communicate an observation of such, seen during the approach of a storm, in 1854 or 1855, when walking from Altrincham to Timperley.

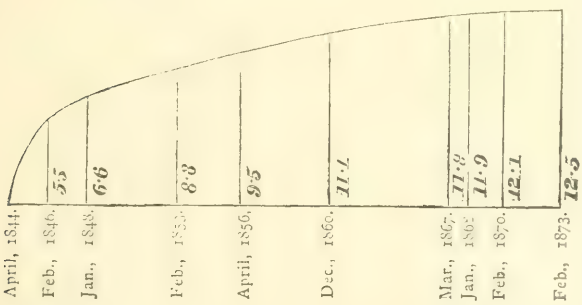
Over the edge of a cloud near the east horizon a flash of lightning was seen, and a ball, *apparently* the size of

one from a Roman candle, shot upwards through an arc of 20° or 30°. I cannot say that it went to another cloud, but that would most likely be so, as my attention was taken up watching the progress of the electric ball.

Mr. Brockbank, F.G.S., exhibited specimens of iron manufactured by the old Bohemian process from hematite ores in the South of Europe. Similar iron has also recently been sent to England from Japan, the high prices now ruling having attracted supplies of iron from distant countries.

Finished bar iron is produced at the present time, in countries where labour is cheap and charcoal plentiful, at an exceedingly low price as compared with present values in England. The specimens now exhibited cost only £6 per ton for the bloom and £8 per ton for the finished bar. The sizes of the bars are, however, very small; but it is a remarkable fact that on so small a scale iron of the very highest quality can be made and sold at half the price of English bars made on the largest scale with all the advantages of our modern machinery and appliances. It is believed that this iron is made by a similar process to that followed by the Romans in Britain, the remains of furnaces or "bloomeries" on Ennerdale Lake being of this class.

The President said that he had made another observation of the position of the freezing-point in the thermo-



meter used in making the observations recorded in the *Proceedings* for April 16, 1867, and February 22, 1870. The gradual rise of the zero during twenty-nine years will be seen by the adjoining diagram, the ordinates representing divisions etched on the glass stem, each corresponding to $\frac{1}{129}$ of a degree Fahrenheit.

"*On the Influence of Acids on Iron and Steel*," by William H. Johnson, B.Sc.—Will appear in our next.

Ordinary Meeting, March 18th, 1873.

J. P. Joule, D.C.L., LL.D., F.R.S., &c., President, in the Chair.

Mr. James Cosmo Melvill, M.A., F.L.S., was elected an Ordinary Member of the Society.

E. W. Binney, F.R.S., V.P., said that during the last week an interesting controversy had been going on in this city between the Town Clerk and the Professor of Chemistry at the Royal Institution as to the quality of the water supplied to Manchester. These disputants are well able to wage their own warfare, therefore it is not my intention to interfere with them. In these days no one doubts the blessings of a constant supply of pure and good water; but the latter quality is determined in a great measure by the purpose for which it is intended to be used. If for manufacturing and washing, then a pure soft water is no doubt most desirable; but it is very questionable if such a water, when conveyed any considerable distance in leaden pipes, is the best for the drinking purposes of a town population.

In the Report of the Commissioners for Inquiring into the State of Large Towns and Populous Districts, Dr. Lyon Playfair, the Commissioner who reported on the then supply of Manchester, appears to have directed little attention to the quality of drinking water for a town population which had to a great extent left off using the milk, porridge, brown bread, and oatcake of our forefathers, and resorted to sloppy tea, white bread, butter, and a little meat, for at page 411 of his Report he says—"In considering the best means for the extension of this benefit," alluding to a constant supply, "to the working classes, or in sanctioning the formation of new waterworks, it would be highly advisable to obtain evidence as to the quality of the water, particularly with regard to its harshness. The value of attention to this point will be obvious, when the difference of consumption of soap is considered. I found by various trials, in summer, that the Manchester water possesses a hardness equivalent to what would be obtained if 13 or 14 grains of chalk were dissolved in a gallon of pure water." The learned Commissioner gives the water at Aberdeen at 1 grain of chalk per gallon, and comparing that with the 14 of Manchester and the 12 of London, he concludes—"Thus the hard water of Manchester may be regarded as increasing the water-rent to a family of five individuals 16s. 8d. per annum, or £49,363 per annum to the whole town, a sum nearly double that of the present water-rental. But large as the cost entailed upon a town by a bad selection of water in the unnecessary consumption of soap, still greater loss is incurred in the wear and tear of clothes." This was written about thirty years since, and I have not the death-rate of Manchester in 1842. In that space of time how much money has been expended in Manchester by the public authorities in shutting up cellar-dwellings, closing grave-yards, removing pig-styes, altering ashpits and middens, opening new streets, and supplying pure water? I cannot tell its amount, but every ratepayer knows practically that it is very large. In looking at the rate of mortality for the week ending March 8th, as given in the *Manchester Guardian*, in the 21 leading places in the kingdom, it was at the annual rate of 28 per thousand. In London the rate was 27; Bristol, 31; Wolverhampton, 28; Birmingham, 28; Nottingham, 27; Liverpool, 31: Manchester, 36; Bradford, 26; Sheffield, 27; Newcastle-on-Tyne, 31. Now I believe the first-named five towns are supplied with hard water, and give an aggregate of 141, whilst the latter five are supplied with soft water, and give an aggregate of 151. This is a significant fact, and worthy of grave consideration. True it is only one week, and a whole year ought to be examined; but I imagine the results, if carefully gone into, will give no advantage to the use of pure soft water when compared with hard, for 27 is a very high rate for London. In building up the skeleton of an adult large quantities of the phosphates and carbonates of limes are required. The well to do, who consume plenty of butchers' meat, cheese, and new milk, may manage to obtain what nature requires; but for the poor, who live on sloppy tea, fine white bread, a little butter, a trifle of meat, and plenty of soft water, where are they to get their necessary supply from? It is not my intention to assert that the high rate of mortality is all due to soft water. No doubt there are many causes which help to produce it, but good, wholesome drinking water, containing carbonate of lime, and plenty of fresh air, which is hard to get in a close and crooked-built town of high warehouses, have, in my opinion, much to do with it. In my own case, I put a little lime in the drinking water used in my house, and I live on a sandy hill, well exposed to the winds of heaven. In all sanitary arrangements too much attention cannot be given to providing plenty of fresh air and as much light as practicable.

"*On Methyl-alizarine and Ethyl-alizarine*," by Edward Schunck, Ph.D., F.R.S. (See page 171.)

The President exhibited a syphon barometer, the peculiarity of which consisted in the introduction of a small quantity of sulphuric acid over the ends of the mercurial column.

Mr. Spence, F.C.S., communicated to the Society the result of an experiment in heating a diamond, which will considerably modify the general impression as to that gem being combustible only at an extremely high heat.

A friend of his had brought over a number of diamonds from the African mines. Some of these were what is called "off colour," not being purely white, and he put one of these into Mr. Spence's hands to try some experiments for displacing the colour if practicable.

This diamond, the size of a small pea, was immersed in fire-clay in a small crucible, the clay being mixed with a little carbonate of soda and hydrate of lime; the crucible was then placed in a muffle, and for three days and nights exposed to a heat which at no time was beyond a low cherry-red. After cooling, the crucible was broken, and the lump of hardened fire-clay was carefully broken up to extract the diamond; after two or three fractures of the lump, an impression or hole in the indurated clay was discovered just at the spot where the diamond should have been, but not a vestige of the precious stone remained.

The only explanation of its departure that seems feasible is, that the soda carbonate, causticised by the lime hydrate, had, by its affinity for carbonic acid, assisted the oxygen of the atmosphere getting through cracks in the clay, to oxidise the pure carbon of which the diamond is composed at a vastly lower temperature than would in ordinary circumstances have been required; at all events this gem was entirely volatilised at a very low red heat.

NOTICES OF BOOKS.

Wœhler's Outlines of Organic Chemistry. By Rudolph Fittig, Ph.D., &c. Translated from the Eighth German Edition, with Additions, by Ira Remsen. Philadelphia: Henry C. Lea.

A well-arranged, compact, and at the same time comprehensive, manual of that department of chemistry which is still known by the provisional name "organic." The circumstance, mentioned by the translator in his preface, that the work, in its original German form, has gone through eight editions in rapid succession, is sufficient proof of its value. The author informs us that it is intended not as a "Text-book of Organic Chemistry, in the usual acceptation of the term, but a guide in connection with instruction. This accounts for and justifies the general brevity of treatment. The work includes the most recent discoveries, and can be confidently recommended to the student.

Outlines of Physiological Chemistry, including the Qualitative and Quantitative Analysis of the Tissues, Fluids, and Excretory Products. By C. H. Ralfe, M.A., M.B. London: H. K. Lewis.

This work commences with a summary of the objects of physiological chemistry. Next follows an introductory section on the composition and constitution of organic substances, the author, as he states in his preface, adhering to the "typical formulæ of Gerhardt instead of adopting the constitutional formulæ which now replace them in the more advanced (?) works on chemistry." We have then a succinct but clear account of the proximate principles, organic and inorganic, found in the animal system. We incidentally note the following passage:—"The various salts (with the exception of sodium chloride) pass through the system unaltered, and are recoverable from the urine and fæces." It is not long since it was proclaimed, with great flourish of trumpets, that unalterability in the system and elimination unchanged were the characteristics of a poison; yet it is now fully known that these attributes belong equally well to salts not merely innocent but necessary to the well-being of the system.

With the statement that "copper is only incidentally present in the tissues" we cannot agree. In the blood of the *Limulus* it is present in notable quantity, replacing iron more or less completely at different seasons of the year. In the red feathers of the Touraco copper is also a normal constituent, as was proved by Church, and fully confirmed by the editor of this journal.

Part IV. treats of the tissues and fluids, with their average composition in the human species. Tolerably detailed instructions are given for the quantitative analysis of blood, with its spectroscopic characters, an engraving of its absorption spectra, and directions for the recognition of blood-stains.

The determination of cream in milk by means of the lactometer is more a domestic than a chemical process. It happens that in a watered milk the cream separates out more completely and more readily than is the case with genuine samples. The analysis of urine, both normal and morbid, is described in detail, as also the characteristics of the principal urinary sediments and calculi.

The appendices treat of the metric system of weights, of the apparatus needed in the analysis of animal compounds, and of the preparation of standard solutions.

Dr. Ralfe gives, lastly, a list of authorities referred to. We cannot help regretting that the "Zoo-Chemical Analysis" of Gorup-Besanez has not been consulted.

We can recommend the book to medical students who wish to familiarise themselves with that part of chemistry bearing most directly upon their profession.

Varnish for Labels.—At a recent meeting of the Newcastle-upon-Tyne Chemical Society, Prof. Marreco said that Prof. Markoe (of Boston, U.S.) told him, some months ago, that the practice in Boston was never to varnish a label for acid bottles, but to use paraffin instead. They had applied it to a large number of bottles in the college laboratory, and it answered perfectly. The only thing necessary was to brush the paraffin on as hot as possible, so as to get a thin even coating; it looked as well as varnish, and stood a great deal better. It saved a good deal of trouble in sizing and varnishing, and five minutes after the bottle had been brushed it was ready for use. Dr. Lunge said that he had read some months ago, in a German journal, that the use of paraffin could be extended a great deal further; that instead of sealing the tops of bottles—sample bottles of bleaching-powder, and for other purposes—it was very convenient to have a small porcelain dish with paraffin always ready, which could be placed upon a lamp, and, as soon as it was warm, to dip the top of the bottle in it, and that gave as good a sealing as sealing-wax, or better, and caused very much less trouble. It had also been proposed to use stoppers made of solid paraffin for caustic soda samples; but he did not like this, because they broke so easily. What he had found to answer perfectly well was to rub some heated paraffin upon the stoppers in place of tallow. He found it a great deal cleaner, and answering in every way for this purpose.

Memorial to the late Prof. Sedgwick.—At a meeting held on Tuesday, the 25th ult., which was attended by a large number of scientific friends of the late eminent geologist, resolutions were passed that a geological museum be erected, to be called the Sedgwick Museum, and that a bust of the Professor should be placed in it. A Cambridge and a London Committee were appointed.

THE CHEMICAL NEWS.

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ON

DETERMINATION OF WAVE-LENGTHS BY MEASUREMENTS WITH A PRISMATIC SCALE.*

By Professor A. S. HERSCHEL.

THE following table of numbers will show how the method can be used with small spectroscopes. The second column of the table gives the inverse fourth power of the wave-length, or the fourth power of the number of whole undulations in 1 m.m. of each of the Fraünhofer rays named in the first column. The third column contains the differences of these numbers, which are very nearly proportional to the intervals between the same lines, as measured with a scale of equal parts in ordinary spectroscopes. The fourth and fifth columns contain the observations of the same lines made by Dr. Huggins with a spectroscope divided into minutes of arc, each of which represented four units of his scale, and the measured intervals between the lines. In the next column, the latter intervals are brought into comparison with the differences of the first calculated numbers of the table by multiplying them severally by the number 0·0077, corresponding to the calculated and observed intervals between the extreme lines B and H, of the spectrum in the two cases. Even with this wide range of comparison between the spectra, it will be seen that the calculated intervals are nearly equal to those obtained from the observations, or are nearly proportional to the observed ones.

Table of Inverse Fourth Powers of Wave-Lengths.

			Dr. Huggins's Prismatic Scale.		
(1.)	(2.)	(3.)	(4.)	(5.)	(6.)
Fraünhofer lines.	Inverse fourth power of wave-lengths: 1 m.m. as unit.	Differences.	Observed position.	Intervals.	Intervals (compared with standard differences in column 3).
	Billions.				
B	4·454		449		
		0·969		140	1·078
C	5·423		589		
		2·870		413	3·179
D	8·293		1002		
		4·672		597	4·595
E	12·965		1599		
		5·087		601	4·626
F	18·052		2200		
		11·401			
G	29·453		(2[illegible]	3077	23·685
		12·169			
H	41·622		5277		
Difference for the whole spectrum		37·168		4828	37·168

The complicated law of dispersion of light by glass prisms does not simply admit of a more exact approximation than this rule affords; but, if the comparison is confined to a smaller part of the spectrum than its whole range, sufficiently close measurements of wave-lengths may be obtained by this method. To calculate, for example, the wave-length of the line C from Dr. Huggins's observation of that line, and of the lines near it, B and D, of which the calculated interval by the table is 3·839, the measured intervals of C, and D from B are respectively 140, and 553 in Dr. Huggins's scale. Hence, by the rule of simple proportion, we find the interval of the line C from B on the scale of inverse fourth powers, thus—

$$553 : 3{\cdot}839 :: 140 : x,$$

and $x = 0{\cdot}972$, the interval required. Its real value is 0·969, as given in the table. By using fuller tables, containing inverse fourth powers of more numerous spectral lines, much closer approximations of the results might readily be obtained.

To determine the wave-length of the line C, as thus found by comparison with B and D, the interval from B is added to the tabular number for that line, thus $4{\cdot}454 + 0{\cdot}972 = 5{\cdot}426$, and the square root of the sum is extracted twice, giving 1·526, which, multiplied by 1000, is the number of undulations of the ray C in 1 m.m.* The length of each undulation in tenth-metres (or ten-millionth parts of a millimetre) is found by dividing 10,000,000 by the latter number, thus:—

$$\frac{10{,}000{,}000}{1526} = 6553.$$

Angström's determination of the wave-length of the line C is 6561 tenth-metres, differing only by a small quantity from this result. With the larger kind of spectroscopes, lines nearer to each other in the spectrum than B and D would generally be chosen for comparison, and a more complete table of them, for such instruments, would be of great practical value; but with the simple means of measurement now devised and adapted by Mr. Procter to pocket spectroscopes, which are ordinarily of low magnifying and dispersive powers, the above standard numbers of the principal Fraünhofer lines will probably be found to supply a sufficiently copious and useful list for numerical determinations of wave-lengths from such simply and ingeniously recorded observations.

NOTE ON A

BRITTLE VARIETY OF SILVER FROM BOLIVIA.

By FREDERICK FIELD, F.R.S.

A SPECIMEN of silver, weighing about half a pound, has been recently sent from Bolivia. It has a brownish colour, resembling very much the minerals Domeykite or Algodonite (Cu_6As and $Cu_{12}As$), for which it was at first mistaken. Like those interesting compounds, it afforded a brilliant white metallic streak with the knife, and was capable of being reduced to powder to a great extent by the pestle. Analysis proved, however, that it contained neither copper nor arsenic, but consisted essentially of silver, with percentages of chlorine, ferric oxide, carbonate of lime, and a small amount of cobalt. After digestion for some days with dilute acetic acid, the carbonate of lime was entirely dissolved, and the brittle residue pulverised and quantitatively examined. It yielded—

Silver	78·12
Chloride of silver	12·01
Ferric oxide	9·34
Cobalt	0·40
	99·87

The analysis presented no peculiar difficulties, and, as it is known to chemists that a mixture of silver and its

* Read before the Newcastle-upon-Tyne Chemical Society.

† N.B.—A different line, lying much further from F towards H than that represented as G in the determinations of wave-lengths by Angström and other authors, appears to have been here observed, and represented by Dr. Huggins in his table of the metallic spectra as the line G of Fraünhofer's spectrum.

* The number of oscillations in a millimetre thus obtained by the double extraction of a square root is the scale adopted as the standard scale for recording spectral lines, in which a considerable table of them is being published by the British Association. The place of a line on this standard scale may readily be obtained directly, as above from the observations.

chloride is very brittle, this little note would scarcely be worthy of record were it not for the fact that the silver in the mineral, after precipitation in the state of chloride from its solution in nitric acid, remained perfectly white after being exposed to sunlight for many days, while the metallic chloride, existing *as such* in the mineral, blackened immediately on exposure to light. Thus, when the powdered ore is treated with nitric acid, and the solution precipitated by hydrochloric acid, the resulting compound after thorough washing is not affected by the sun; whereas the residue, after digestion with weak solution of ammonia, filtration, and precipitation by an acid, yields a chloride of silver which is at once discoloured. This peculiar property of chloride of silver has been previously noticed. In a paper by the writer, in the *Quarterly Journal of the Chemical Society*, vol. x., p. 242, the following observation may be found:—"Lœwig has shown that chloride of silver is soluble to a considerable extent in nitrate of mercury, and crystallises, as the solution cools, in octahedra. When solutions of nitrate of silver and corrosive sublimate are mixed together, a precipitate of chloride of silver is formed, which, on boiling with the nitrate of mercury produced by the double decomposition, is partially dissolved, and the solution, after filtration, deposits chloride of silver in small crystalline grains. These crystals, after washing with water until no trace of mercury passes, and exposed to the sun's rays, do not blacken like the ordinary chloride. A considerable quantity was prepared and exposed moist to the direct rays of the sun for a month, and remained unaltered in appearance."

ON THE

INFLUENCE OF ACIDS ON IRON AND STEEL.*

By WILLIAM H. JOHNSON, B.Sc.

I.—*General Effects of Acid.*

PIECES of iron and steel wire of various qualities were immersed in sulphuric or hydrochloric acids for spaces of time varying from ten minutes to twelve hours, and then well washed with water and dried, and the following experiments made:—

1. On breaking one of the pieces of wire, and moistening the fracture, still warm from the effort of breaking it, bubbles were seen to rise through the water from the *whole* surface of the fracture, even when the piece was 0·412 inch diameter. Further, pieces of wire that had been immersed in acid, washed, coated with lime, dried, and drawn to a smaller diameter, thus removing any trace of acid on the surface, gave bubbles in the same manner. The bubbles are most abundant if the iron has been immersed in sulphuric acid, and may be seen several days after the iron has been removed from the acid. If steeped in hydrochloric acid, the bubbles are seen with difficulty and only after long immersion.

Bubbles are not apparent with steel, even after prolonged immersion, except the steel be very mild.

Test-paper was not sensibly altered in colour by the water on the fractures.

By exposure to the atmosphere, or more quickly by steeping in water, the above phenomena, as well as those to be mentioned later on, decrease in intensity, until at length they are no longer visible and the iron is quite restored to its original state; gentle heat greatly aids this. They also cease to be visible sooner if hydrochloric acid be employed than if sulphuric acid is used, doubtless because the latter is less volatile.

2. The fracture of a piece of iron or steel, immersed for one hour or more in either acid, is somewhat darker in colour than before. After several hours the fracture may be black in the centre, and more or less crystalline in appearance.

3. Pieces of iron or steel, heated in a confined space, after immersion in acid become slightly rusted. If air has free access during the application of heat, this is not the case.

It thus appears that heat expels the dilute acid from the interior of the iron, which, if not carried away with sufficient rapidity by the surrounding air, attacks the surface of the iron, forming an oxide or oxychloride of iron.

Sometimes, instead of a uniform coating of rust, the iron is simply spotted. The acid will in some cases, after lapse of time, find its way to the surface of the iron, and spot it with rust, even without the application of heat; this is particularly the case with iron which has been soaked in sulphuric acid.

It is this power which iron possesses of absorbing acid, and afterwards giving it off, which accounts for the difficulty hitherto experienced of coating iron with copper, tin, or any other metal in acid solutions; for the acid, on coming to the surface of the iron, is unable to make its way through the impervious coating of metal, and consequently, combining with the iron at the surface, forces the copper or tin off.

4. The universal effect of acid on iron and steel is to decrease its toughness. This brittleness is most marked with steel. Sometimes a coil of steel wire after immersion in acid will break if allowed to fall on the ground, and I have seen hardened steel, and steel containing a large percentage of carbon, fly in pieces as soon as it was immersed in acid without being touched at all.

II.—*Effect on the Weight.*

Pieces of iron and steel were immersed in acid for different periods of time, well washed in water, and weighed; they were then heated in a kitchen oven, and again weighed. The results are given in the table on opposite page.

In all cases except one they were found to have lost in weight, and the exception was probably owing to the increased weight caused by a slight coating of oxide overbalancing the loss occasioned by heating.

The gain in weight by immersion in H_2SO_4 is greater than by immersion in HCl.

In Experiments 1 to 4 the gain per cent is—

For immersion in HCl .. .. = 0·010659
For immersion in H_2SO_4 .. .. = 0·025126

or almost as 2 to 5—more accurately as 1 : 2·357.

In Experiments 5 to 7 the gain per cent for—

HCl .. .. = 0·02918
H_2SO_4 .. .. = 0·03714

as 1 : 1·284.

Experiments 9 to 13 show how rapidly steeping in water removes what the iron has taken up by immersion in acid; the loss in weight on subsequent heating being only about one-tenth of that in previous experiments where the iron had not been immersed in water any length of time.

III.—*Effect on the Breaking Strain and Elongation.*

The effect of immersion in acid on the breaking strain and elongation of iron wire naturally suggested itself as an interesting subject for inquiry. Accordingly a number of pieces of iron wire were immersed in hydrochloric acid for one or more hours, and then carefully tested for elongation and breaking strain. The pieces were then heated on a hot plate for some hours, and again tested, with the following general results:—

1. That immersion in acid dimishes the breaking strain of iron wire from ½ to 3 per cent, and steel wire about 4·76 per cent.

2. That immersion in acid appears in some cases to diminish, in others slightly to augment, the elongation of iron wire, and to augment the elongation of steel wire about 30 per cent.

Subjoined are the results of a few of the experiments on iron wire.

* Read before the Manchester Literary and Philosophical Society.

TABLE SHOWING THE INCREASE OF WEIGHT AFTER IMMERSION IN ACID.

	Quality.		Hydrochloric Acid. Weight in Grams. Before Heating.	Hydrochloric Acid. Weight in Grams. After Heating.	Hydrochloric Acid. Loss by Heating.	Hydrochloric Acid. Gain per cent by Immersion.		Sulphuric Acid. Weight in Grams. Before Heating.	Sulphuric Acid. Weight in Grams. After Heating.	Sulphuric Acid. Loss by Heating.	Sulphuric Acid. Gain per cent by Immersion in Acid.
1.	Steel	0·124	49·81525	49·81500	0·00025	0·000502	*	50·56990	50·55516	0·01474	0·029156
2.	Mild steel..	0·126	47·36490	47·36020	0·00470	0·009923	*	43·85070	43·84990	0·00080	0·022350
3.	Best iron ..	0·122	47·48030	47·47495	0·00535	0·011269	†	43·25005	43·24065	0·01040	0·024052
4.	Char. iron..	0·125	43·20994	43·20020	0·00974	0·022540	†	42·34002	42·32974	0·01028	0·024285
	Total ..		187·87039	185·85035	0·02004	0·010659		180·01967	179·97445	0·04522	0·025126
	In acid five hours, then washed several times in water, and heated eighteen hours in an oven.										
5.	Mild steel..	0·165	78·69240	78·65170	0·04070	0·051870		71·36530	71·32490	0·04040	0·056640
6.	Best iron ..	0·165	81·68530	81·67220	0·01310	0·016040		85·98500	85·94000	0·03500	0·040720
7.	Char. iron..	0·165	78·69240	78·65170	0·01595	0·020280		84·09020	84·07515	0·01505	0·017960
	Total ..		239·07010	238·97560	0·06975	0·029180		241·44050	241·34005	0·09045	0·037470
	In acid three and a half hours, then well washed in water. Heated eighteen hours.										
8.	Steel	0·165	80·08010	80·06770	0·01240	0·015480		—	—	—	—
	In acid twelve hours. Heated thirty hours.										
9.	Steel	0·180	—	—	—	—		79·10020	79·09005	0·01015	0·012830
10.	Mild steel..	0·182 ‡	—	—	—	—		77·56980	77·56990	−0·00010	—
11.	Best iron ..	0·155	—	—	—	—		74·92055	74·91722	0·00333	0·004400
12.	Charcoal ..	0·158	—	—	—	—		61·42040	61·41990	0·00050	0·000814
13.	Ditto. ..	0·420	87·45715	87·45500	0·00215	0·002450		—	—	—	—
	In acid twelve to thirteen hours, then steeped in water for ten hours. Heated twenty-four hours.										

* Appearance of fracture crystalline, speckled and white; after heating, finer and greyer. † Annealed. ‡ Very slightly rusted after heating

Quality.	No.	Elongation. Immersed in Acid 1 hour. Per cent.	Elongation. Heated. Per cent.	Breaking Strain. Immersed in Acid 1 hour.	Breaking Strain. Heated.
Annealed iron wire, 0·164 in. diam.	1	15	22	1176	1168
	2	19	20	1176	1162
	3	22	19	964	1008
Average ..		18·6	20·3	1105·3	1112·6
Annealed iron wire, 0·150 in. diam.	4	24	22	908	944
	5	24	21	908	930
	6	22	25	896	946
	7	21	23	914	908
	8	22	22	926	924
	9	24	24	920	924
	10	22	23	934	896
	11	22	21	930	928
	12	21	20	924	906
Average ..		22·4	22·3	918·4	922·8
Hard iron wire, 0·136 in. diam.	13	0·5	2	1230	1218
	14	2·5	3·5	1146	1230
	15	2	3	1200	1232
Average ..		2	2·83	1192	1226·6

IV.—*Effect of Pyroligneous Acid.*

The effect of pyroligneous acid on iron and steel appears to be exactly similar to that of hydrochloric and sulphuric acids, causing it to become more brittle, &c., though the effects are perhaps somewhat less intense. As in their case, heat restores the iron to its original toughness.

V.—*Effects of Acids on Copper and Brass.*

Sulphuric acid appears to have no effect whatever on copper. After eighteen hours' or longer immersion in sulphuric acid, copper is as tough as ever, the action being confined to the surface only.

Brass becomes rotten after long immersion in vitriol, doubtless because the zinc of which it is partly composed is attacked by the acid, and, as might be expected, heat does not restore it to its original condition. Prolonged exposure to a moist damp atmosphere appears to make brass brittle, just as acid does.

VI.—*Effect of Zinc on Iron.*

A piece of galvanised iron of good quality, which when cold several times resisted bending to and fro at right angles to itself, was raised to a red heat with such rapidity that only a small portion of the coating of zinc was vapourised. On then attempting to bend it, it broke off sharp, the fracture being short and crystalline. When cold, this piece broke with all its former toughness, the fracture showing a long fibre. The same piece was then heated till all the coating of zinc was driven off; it was then found impossible to break it. This clearly shows that the iron was not red-short, except when rendered so by the zinc.

The same experiments were tried with iron coated with lead and with tinned iron, but without the above results.

Some kinds of iron do not appear to be rendered red-short by zinc.

Possibly the above phenomenon may have some connection with the fact that zinc forms an alloy with iron at a red heat, containing from 2 per cent to 6 per cent of iron, and having a melting-point which is higher as the proportion of iron is greater, while lead and tin do not alloy with iron at this temperature. But still the iron appears to absorb the liquid zinc in a similar way to that in which it appears to take up acid on immersion in it, and with similar results.

Hitherto I have spoken of iron absorbing and occluding acid, as though this something which increases the weight of the iron, alters its tensile strain, &c., had been definitely proved to be acid; but, in the face of my having been unable to obtain any reaction to test-paper, this is very uncertain. Though the fact that the immersion of iron which has been soaked in an alkaline fluid greatly hastens its restoration to its original state, and the rusting of the surface of iron soaked in acid when heated in a confined space, all lead to the belief that acid is absorbed, though other bodies, such as gases, may be occluded at the same time.

The experiments of Professor Graham, in 1867, and more recently those of Mr. Parry, show that hydrogen, carbonic oxide and carbonic acid, and nitrogen are evolved from wrought-iron, cast-iron, and steel when heated *in vacuo*. Therefore it seems probable that a part of the hydrogen produced by the action of the acid on the iron

may be absorbed by the iron, its nascent state facilitating this; and when the iron is heated by the effort of breaking it, the gas may bubble up through the moisture on the fracture.

In Mr. Parry's experiments, while 1 vol. of iron evolved 2 vols. of gas when heated strongly *in vacuo*, 1 vol. of mild steel evolved only 0·13 of a vol. of gas. If, from a small evolution of gas during heating of steel *in vacuo*, we may argue a very small evolution of gas in steel soaked in acid, then we are led to suppose that the bubbles evolved from the hot moist fracture of a piece of steel will be very small or imperceptible, which experiments amply confirm.

THE SPECTRA OF THE METALLOIDS.

THE January number of the *Ann. de Chim. et de Phys.* contains an important memoir by M. Salet, in which that physicist gives the details and results of a long series of researches on this subject. While many of these results are already well known, a brief *resumé* of M. Salet's work in this department of science may not be without value.

The author studied successively each of the families of metalloids established by M. Dumas, and describes for each of these substances the spectrum produced by electricity of high tension, and of low tension, the spectrum of absorption, and the spectrum which it gives on being introduced into a flame. Instead of the ordinary Plücker tubes with interior electrodes, M. Salet frequently used tubes quite similar in form, but of glass not readily fused, so that they might be heated to a red heat during the circulation of a current of oxygen intended to free them of all traces of carbon. Instead of electrodes in the interior, the enlarged extremities were furnished with metallic sheaths.

Hydrogen.—M. Salet obtained from hydrogen only one spectrum, that with three bright lines discovered by M. Angström; these lines being capable of enlargement, more or less, according to the temperature of the discharge. With M. Angström, he attributes the two other spectra which M. Wüllner obtained with hydrogen, the one to acetylene, the other to sulphur. No other spectrum of absorption was obtained from this gas than that furnished by the atmosphere of the sun and of several stars. The author was unable to obtain a discontinuous spectrum by the combustion of hydrogen in oxygen or in chlorine; the spectrum was always complete.

Chlorine.—From the difficulty of preparing with the mercury pump a Geissler tube of chlorine, M. Salet preferred to use a tube filled with this gas at ordinary pressure, making the disruptive discharge of the electric machine traverse it. For the detailed description of the spectrum thus obtained we must refer to the original memoir. M. Salet did not observe the absorption-spectrum of chlorine, and did not obtain a discontinuous spectrum from this substance by combustion.

Bromine.—With the disruptive discharge through bromine a yellow spark is obtained, and a spectrum composed of a great number of lines or of resolvable bands. With the induction coil the spark is nebulous, straight, and enveloped by a less luminous sheath. This sheath gives a pale continuous spectrum; it is formed by vapour of bromine heated red-hot. M. Salet observed, indeed, that the vapour of bromine may be rendered luminous by submitting it to a temperature sufficiently high, in a glass tube not readily fused, or by placing in it a platinum spiral kept incandescent by a current. The spectrum then furnished is continuous; but it is probable, he adds, that, with a greater illumination the bands of the first order would become visible.

Bromine gives an absorption-spectrum composed of shaded bands, without coincidence with the lines of the spectrum from disruptive discharge, and forming, so to speak, the negative proof of what Plücker has called a spectrum of the first order. There is no doubt, says M. Salet, that the molecules of bromine, the electric absorption of which causes these *minima* in the spectrum, would be capable, if luminous in the same circumstances, of emitting a light characterised by corresponding maxima. There are, then, *two spectra of bromine.*

Bromine introduced into the hydrogen flame did not give a discontinuous spectrum.

Iodine.—Iodine introduced into a glass tube from which the air had been carefully expelled, was then heated so as to fill the tube with a vapour more or less dense. With the coil, and with sufficient pressure, a bluish spark was produced, enclosed in a fusiform orange sheath which gives a continuous spectrum, while the spark gives a spectrum composed of a large number of bright lines. With the induction spark in a tube having external metallic armatures, and containing vapour of iodine at a very low pressure, a spectrum was obtained consisting of three luminous diffuse maxima; one of which, in the red, was divided by flutings. This is the primary spectrum of iodine. The red flutings correspond with the bands of the iodine absorption-spectrum, which forms, in some sort, the negative proof of the primary spectrum of this substance, while there is no coincidence between the absorption-spectrum and the spectrum of the second order.

Iodine can be heated to red heat much better than bromine; and, round an incandescent platinum spiral introduced into vapour of iodine, a veritable *flame without combustion* is produced.

Fluorine.—M. Salet endeavoured to determine certain elements, at least, of the spectrum of fluorine, by comparing the spectra of chloride and fluoride of silicium, and eliminating the common lines.

Oxygen.—The description given of the spectrum of bright lines corresponds to that given by Angström, but some lines are added. On the other hand, there are wanting some lines which have been attributed to this gas by Plücker and Hittorff. Oxygen gives neither a spectrum of absorption nor a spectrum of combustion.

Sulphur.—The spectrum of this metalloid was studied with a tube having external metallic armatures, and containing a little sulphur, which was heated more or less according to the pressure desired in the vapour thus produced. With the induction coil and low pressure, a spectrum of the first order of Plücker and Hittorff was observed. With the spark from a Holtz machine the spectrum observed was, on the contrary, entirely composed of bright lines, of which the author gives the wavelengths.

The absorption-spectrum of sulphur is difficult to obtain. The dark bands are especially visible in the blue; they coincide with those of the primary spectrum. The introduction of a certain quantity of sulphur into the hydrogen flame produces, in the portion of this flame having the highest temperature, a bluish-violet colouration, which, studied with the spectroscope, gives the primary spectrum of sulphur. The coloured space may be considerably increased by pressing the hydrogen flame against a sheet of water; the entire surface of contact becomes coloured with this blue light, which can then be spectroscopically analysed. The author considers that by this process one may detect, by simple colouration, without using the spectroscope, the presence in a hydrogen flame of 0·000002 gr. of sulphur.

Selenium.—Selenium gives also two different spectra—one of the first order, which may be obtained by combustion, either by volatilising the substance in coal-gas, or in a sheathed tube traversed by the current from an induction coil; and a spectrum of the second order, when the substance transmits the discharge of a Holtz machine.

Tellurium.—This metalloid also gives two spectra. The band-spectrum may be observed with a sheathed tube containing a little tellurium (the air having been expelled), and heated to a red heat, the induction current being then made to pass; also with the flame of a jet of hydrogen containing volatilised tellurium. The spectrum of the

second order can be obtained by the same process as that of the metals.

Nitrogen.—M. Salet obtained the band-spectrum of Plücker and Morren both with dried ammonia and with air, and thus demonstrated that it belongs really to nitrogen; a result confirmed by M. Wüllner by experimenting with this gas, not in combination, but prepared as pure as possible. The line-spectrum of nitrogen is obtained with the disruptive discharge. M. Salet, then, considers that nitrogen gives two spectra; an opinion contrary to that held by M. Angström and M. Schuster.

Phosphorus.—M. Salet could not obtain the band-spectrum by passage of electricity through phosphorus. Even with electricity of low tension he always observed the line-spectrum he describes. Phosphorus colours the hydrogen flame with still more intensity than sulphur. By using a sheet of water, or sending about the flame a quick current of cold air, this colouration, which is green, may be considerably increased, and one may then observe a bright spectrum of the first order, which is, with some bands in addition, the spectrum described by MM. Christophle and Beilstein. The coloured flame, obtained by the burning in air of a jet of hydrogen containing volatilised phosphorus, gives the principal bands of this spectrum.

Boron.—By the passage of the disruptive discharge in chloride or fluoride of boron, the author obtained a line-spectrum which yet was not sufficiently well defined for precise description. On the other hand, he describes the primary spectrum produced by the introduction of chloride or fluoride of boron, as also of boric acid into the hydrogen flame.

Carbon.—The results obtained for this substance were obtained from a study of the spectra of its compounds.

Silicium.—A beautiful line-spectrum may be obtained from the induction spark passing between two poles of silicium. The lines of silicium are found in the spectra of all the haloid compounds. These compounds give combustion-spectra of bands, which, with certain portions in common, vary notably from one combination to another.

M. Salet's researches, thus briefly sketched, form a valuable contribution to the science of spectrum analysis.

A. B. M.

NEW PROCESS FOR THE MANUFACTURE OF SULPHOCYANIDE OF POTASSIUM.*

By W. SKEY, Analyst to the Geological Survey of New Zealand.

The methods by which this salt is now prepared for laboratory and other purposes necessitates several purifying processes, in order that the ultimate product may have the degree of purity required; thus we have first the formation of the crude article, by heating to tranquil fusion dry ferrocyanide of potassium with sulphur, and this product has to be treated in various ways in order to remove sulphocyanide of iron, alkaline sulphides, &c., from the salt in request.

The processes therefore necessary to accomplish this purification must largely add to its cost. To save this expenditure in labour and material I have sought to effect the economical manufacture of this salt by the application of a process or reaction which I have taken advantage of in discriminating the state in which sulphur exists on the surfaces of sulphurised gold.† This process consists in applying cyanide of potassium to such compounds at common temperatures, when any sulphur present in a free state would combine with it to form a sulphocyanide, but if present as a sulphide would only be transformed into a soluble sulphide.

In my first experiments, however, for the purpose of preparing this salt direct from cyanide of potassium and common flour of sulphur, I found that unless the temperature of the mixture was raised considerably, only a very small portion of the sulphur was taken up, and the product was then contaminated with the impurities I designed to omit.

This refusal of sulphur to combine freely with the cyanide at common temperatures was, I found, entirely due to the presence of some gas, probably air, which substance may readily be got rid of, as will suggest itself by pouring the sulphur into boiling water and keeping up ebullition for a few minutes. When the water and sulphur is quite cooled down the cyanide may be added to the sulphur in an equivalent proportion.

The quickest way to effect the combination is to suspend the wet sulphur in a porous bag near the top of the cyanide solution, when in a few days the combination will be complete, and a product obtained comparable in purity with that of the cyanide used. I need not state that the operation should be carried on in an air-tight vessel.

It is absolutely necessary that the cyanide used should be free from caustic alkali, otherwise sulphides would be generated: it is but rarely, however, that cyanide is thus contaminated.

If the precautions indicated are taken, the product is sufficiently pure for use in all the ordinary applications to which this salt is put in the laboratory.

* Read before the Wellington Philosophical Society.

† See *Trans. N. Z. Inst.*, vol. iii., p. 376.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Ordinary Meeting, April 3rd, 1873.

Dr. Odling, F.R.S., President, in the Chair.

The minutes of the two previous meetings having been read and confirmed, Messrs. O. W. Sheppard and George Browney were formally admitted Fellows of the Society. The Secretary then announced the donations which had been made to the Society, and proceeded to read the names of candidates for election. For the first time—Messrs. Isidore Bernadotte Lyon and John Henry Baldock. For the third time—Messrs. E. H. Fison; Charles Thomas Kingzett; Alonzo J. Rider; William Andrew Prout, B.A.; Roland Finch; William Morgan, Ph.D.; and Henry Richardson, who were balloted for and duly elected.

The first paper, "*On a Method of Determining with great Exactness the Specific Gravity of Liquids*," was read by the author, Dr. H. Sprengel. His instrument consists of an elongated U-tube, furnished at each extremity with a capillary tube bent at right angles, one of which is drawn out to a fine point, and the other has a fine mark on it near the bend. The apparatus is first filled through the open capillary tube by means of suction applied at the one drawn out, and is then placed in a vessel of water maintained at the standard temperature. As soon as the temperature of the instrument and its contents has become constant, the volume of the liquid is adjusted by absorbing any excess from the drawn out end by means of filter-paper. It may then be removed from the water, carefully dried, and weighed. If the temperature be adjusted with care to 0·01° C., determinations may be made with accuracy to the fifth decimal place. The author described certain details necessary in using the instrument, and also gave results illustrating its great accuracy.

The President having thanked the author in the name of the Society for the description of his valuable and ingenious apparatus, Dr. Dupre remarked that he could fully testify to the great delicacy of the instrument, but it was necessary, in order to insure accurate results to the fifth place of decimals, to observe certain precautions.

The balance must be capable of weighing within 1-10th milligramme, the temperature must be very accurately determined, and the barometer must be observed during the weighings, or else a facsimile of the instrument should be used as a counterpoise.

"*Researches on the Action of the Copper-Zinc Couple on Organic Bodies*" (No. II., "On the Iodides of Amyl and Methyl"), by J. H. GLADSTONE, F.R.S., and A. TRIBE, was then read by the former. Dr. Gladstone said he might be permitted to remark, in reference to the black deposit of the copper-zinc couple, that it generally contains more or less zinc; but the black colour does not depend on its presence, for copper deposited on zinc in strongly acid solutions is black; moreover, some specimens of the black deposit do not effervesce with acids; and, finally, the black deposit, when treated with sulphate of copper, retains its colour, so that the blackness seems to be due to the finely-divided state of the metal, as in the case of platinum black.

The couple was found to have no action on amylic iodide at 100°, whilst at the boiling-point of the latter substance secondary products were produced, probably owing to the high temperature. When, however, the two were digested together at 145°, a white crystalline compound perfectly analogous to ethiodide of zinc was formed, together with some amylic hydride, amylene, and amyl. The contents of the flask, submitted to distillation, yielded 20 to 30 per cent of zinc amyl, mixed with the hydrocarbons simultaneously produced, and from which it may be approximately separated by fractionation. On distilling the amyl-iodide of zinc *in vacuo*, upwards of 40 per cent of the theoretical amount of zinc amyl was obtained. With respect to the decomposition which takes place in the presence of water or alcohol, the analogy between amyl- and ethyl-iodides is perfect, pure amyl-hydride being produced.

The dry couple has no action on methyl-iodide either at the boiling-point of the latter or at ordinary temperatures; in presence of water or alcohol, however, the methyl-iodide is readily decomposed, giving off methyl-hydride or marsh-gas, thus offering a ready method of preparing that gas in the pure state.

The PRESIDENT, in thanking the author for his interesting communication, asked if he had tried the action of the couple on the sulpho-vinates, since it was possible they too might give alcoholic hydrides.

Dr. MILLS suggested that bromobenzine would perhaps yield phenyl when submitted to the action of the couple.

Dr. C. R. A. WRIGHT then read a paper "*On Cymene from Various Sources.*" The author has submitted cymene from eight different sources to careful examination. The methods by which it was obtained were the following:—(1). By acting on myristicol with phosphoric pentachloride, and washing with water, a liquid was obtained which, heated to 170° to 190°, evolved hydrochloric acid whilst a hydrocarbon, cymene, distilled over. (2). By the action of zinc chloride on myristicol, a compound, $C_{20}H_{30}O$, being produced at the same time as the cymene. (3). The product obtained by the action of phosphoric pentachloride on camphor was digested in a flask furnished with a vertical tube as long as hydrochloric acid was given off, and finally the cymene was distilled off. (4). After polymerising the terpenes present in the nutmeg hydrocarbon by the action of sulphuric acid, the unaltered cymene precontained in it was separated for examination. (5). The cymene precontained in oil of turpentine was separated from the terpene by a similar process. (6). Cymene from hesperidene.—On adding bromine to carefully cooled hesperidene, the two unite, forming hesperidine dibromide, which, under the influence of heat, splits up into hydrogen bromide and cymene, the latter amounting to 80 per cent of the hesperidine employed. (7). Cymene obtained by a similar process from the dibromide of the turpentine of nutmeg oil; the yield, however, is very much smaller. (8). Cymene from Cummin oil.

Careful analysis were made of these various specimens of cymene, all of which correspond to the formula $C_{10}H_{14}$. Their boiling-points (corrected), although varying one or two degrees, were all about 176° C.; and by the action of potassium dichromate and sulphuric acid, they all yielded pure terephthalic acid and a certain amount of acetic acid, but no isophthalic acid was produced, neither could any of the higher homologues of acetic acid be detected in the distillate from the chromic liquor. Moreover, the odour, density, refractive and dispersive powers of these eight samples were almost the same, so that there can be no doubt that the cymene obtained from these various sources is identical. In conclusion, the author discussed the relation which existed between cymene and benzol, as exemplified by the known dihydrides of cymene and the oxidation of cymene to terephthalic acid.

The PRESIDENT having expressed the thanks of the Society to the author for his valuable memoir, Dr. ARMSTRONG asked if Dr. Wright had determined the proportion of acetic acid to terephthalic acid produced by the oxidation of the cymene.

Dr. WRIGHT replied that he had been unable to do so quantitatively, but the amount produced was always considerable. He likewise drew attention to the error into which Kekulé had fallen, of supposing that there were two isomeric cymenes, one existing in Cummin oil, and the other obtained from camphor by the action of zinc chloride; this he attributed to the latter being a mixture of various substances, and not pure cymene.

Dr. H. E. ARMSTRONG then read a paper entitled "*Communications from the Laboratory of the London Institution*" (No. XI. "Action of the Acid Chlorides on Nitrates and Nitrites;" Part I., "Action of Acetic Chloride"). The author was in hopes of being able to convert phthalic acid and its isomerides directly into the corresponding dinitrobenzines, by first preparing from them the nitro-compounds analogous to Schützenberger's acetate of chlorine, $C_2H_3ClO_2$, and then submitting these to the influence of heat. The acetate of chlorine under these circumstances splits up into carbonic anhydride and chloromethane, $C_2H_3OCl_2 = CH_3Cl + CO_2$; and the corresponding nitro-body would presumably be resolvable by the same means into carbonic anhydride, and the nitro-derivative of the hydrocarbon. It was thought such a series might be formed by the action of the acid chlorides on the metallic nitrates; for example:—

$$CH_3COCl + AgNO_3 = AgCl + CH_3CO(NO_2).$$

On trying the reaction, however, with acetic chloride, it was found to take place in quite another manner, a mixture of nitric peroxide and chlorine being evolved, and argentic chloride and acetic anhydride left, the ultimate result being expressed by the equation—

$$\left.\begin{matrix} C_2H_3OCl \\ C_2H_3OCl \end{matrix}\right\} + AgNO_3 = AgCl + NO_2 + Cl + \left.\begin{matrix} C_2H_3O \\ C_2H_3O \end{matrix}\right\} O.$$

The author has also examined the action of acetic chloride on nitrites. With the potassic salt, a gas is immediately evolved which somewhat resembles chlorine in appearance, but is readily absorbed by water, and appears to be NOCl; towards the close of the reaction nitric oxide is also evolved. In all probability, the reaction takes place as represented by the equations—

$$CH_3.COCl + KNO_2 = CH_3.CO_2K + NOCl$$

and—

$$CH_3CO_2K + CH_3.COCl = \left.\begin{matrix} C_2H_3O \\ C_2H_3O \end{matrix}\right\} O + KCl.$$

The author proposes also to investigate three other reactions which may be expected to yield the acid nitrates, viz.:—(1) The action of nitrylic chloride on the metallic salts of the acids; (2) the action of nitric anhydride on the acid anhydrides; and (3) the action of nitrylic chloride on the acid anhydrides.

The thanks of the Society having been given to the author for his interesting communication, the President adjourned the meeting until Thursday, 20th of April, when a lecture "On the Heat Produced by Chemical Action," will be delivered by Dr. Debus, F.R.S., &c.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

January 30th and February 27th, 1873.

The President (Dr. Lunge) read the following "*Chemico-Technical Notes from Foreign Sources*":—

1. *On an Improvement in the Manufacture of Caustic Soda.*—It is very well known that the principal impurity in manufacturing caustic soda from "red liquors" or from "tank liquors," which cannot be removed by the process of "fishing," is sodium sulphide, and that the only practicable way for dealing with this compound is oxidising it to sulphate. Formerly, this oxidation was always done by an addition of sodium nitrate, of which from ½ to 2 cwts. per ton of caustic soda were required for the purpose. The quantity of nitrate can be materially lessened by blowing air through the caustic liquor, which oxidises the sulphide, but only slowly and, on a manufacturing scale, never completely if applied in the usual manner, viz., to the caustic liquor in a comparatively dilute state at a temperature necessarily below its boiling-point. Some makers use Hargreaves's process, consisting in forcing air into the liquid by means of a jet of steam, on the principle of Giffard's injector, and thus save a good deal, but never the whole, of the nitrate, and only by a considerable waste of fuel for the steam, which in reality costs much more than would be required for driving an air-pump of corresponding power. This process has been very materially improved by W. Helbig, of Gera, in Thuringia, who injects the air, instead of into the lyes, into the caustic pot itself, when the mass is already in red-hot fusion. The process is now used in most German alkali works, and is carried out as follows:—

The lye is concentrated in cast-iron "pots" as hitherto, up to the point where the cyanides are decomposed with evolution of ammonia and formation of graphite; the froth then subsides, and the mass becomes viscid. The fire is now increased, and the mass brought to a red heat, whereby it becomes more fluid. The pot is now covered with an iron lid, provided in the middle with a small sheet-iron funnel, and close to it with an iron pipe reaching to the bottom of the pot, through which air is forced by means of a pump. The graphite is seen floating on the surface, and can be scummed off, but it is mostly allowed to be burnt, as it is too crystalline to be of any use for lead-pencil making. The oxidation of the sulphides begin immediately, and is controlled by taking samples now and then. The air is blown in to such an extent that the mass is strongly agitated, and this is continued till the sulphides are very nearly, or till they are completely, oxidised, according to whether a white or a somewhat bluish product is desired. Then the fire is drawn, the damper is let down, the mass is allowed to clear for some hours, and then ladled out as usual.

The pipe for injecting the air is most suitably a thick wrought-iron tube, bent in a right angle, and suspended in the bend by a chain going over a pulley. The part reaching into the pot is closed at the end, and has in its side four small openings, in order to divide the air into finer jets; the other arm is connected with a cock attached to the blowing-pumps by means of an india-rubber tube.

2. *On the Cause of the Loss of Sodium in Leblanc's Alkali-Making Process.*—The celebrated manufacturer and chemist, Scheurer-Kestner, of Thann, in Alsace, has proved before that the above loss does not proceed from a reduction of sodium compounds to metallic sodium, which might be volatilised, but that the loss is mostly caused by the formation of insoluble sodium compounds remaining in the "tank-waste." He has continued his researches on this subject, and found that "black ash," obtained on the large scale from 100 sodium sulphate and 95 limestone, left a tank-waste containing on the average 0·39 per cent sodium, whilst a product made from 100 sulphate and 112 limestone left 1·36 per cent sodium in the waste. The average was not appreciably affected by using sometimes a mixing-coal having 18 to 20, and sometimes one having 10 to 12, per cent ashes. A continuation of these experiments showed that the amount of insoluble sodium increases quite proportionately to the amount of limestone employed in the said mixture. It is well known that any excess of limestone in this mixture is for the most part converted into caustic lime, and further researches of the same chemist have shown that it is the latter body to whose presence the larger or smaller percentage of insoluble sodium compounds must be attributed. Hydrate of calcium retains of itself only small traces of caustic soda, and, if boiled with the latter, the washed sediment shows only 0·13 per cent of sodium. But if, instead of caustic soda, sodium carbonate be used, which of course during the process is causticised, the sediment, after being completely washed, still retains 4·75 to 4·95 Na_2O. The latter process of course takes place when dissolving "balls" containing sodium carbonate and caustic lime, and it is quite natural that, as observed in practice, the absorption of sodium by the insoluble residue increases with the increase of caustic lime—that is, with that of limestone in the original soda mixture.

M. Scheurer-Kestner further examined the effect of the porosity of black-ash on the loss of sodium. The tank waste from porous black-ash contained 1·44, that from very dense black-ash 1·97 per cent sodium. This was the result of lixiviating on the large scale; but the two samples of black-ash ground to a fine powder and lixiviated in the laboratory, so that the influence of the larger or lesser porosity was eliminated, showed 0·85 and 0·80 per cent sodium; that is to say, no appreciable difference.

The natural inference is that the quantity of limestone in the mixture for soda-ash ought to be reduced to the lowest point consistent with the quality of the ash.

3. *On the Composition of Bleaching-Powder.*—Dr. Crace Calvert, of Manchester, last year published in the *Comptes Rendus* of the French Academy, a paper on the analysis and composition of bleaching-powder, the upshot of which was that, in opposition to the opinion generally held, when chlorine and slaked lime are brought together, only one-third of the chlorine enters into the state of calcium hypochlorite, and two-thirds into that of calcium chloride. His analytical method consisted in passing a current of CO_2 through a filtered solution of bleaching-powder, boiling, filtering off the calcium carbonate, converting it into sulphate, weighing the latter and calculating it as corresponding to the total of calcium hypochlorite, whilst the calcium chloride is estimated in the filtrate from the carbonate, either by an estimation of chlorine in the usual manner, or by evaporating, drying, and fusing the residue. He asserts that he confirmed his results by exhausting bleaching-powder with absolute alcohol, which only dissolves calcium chloride.

Now, M. T. Kolb, of Amiens, who is well known by his extensive and most careful researches about all processes connected with alkali making, draws attention to the fact that he has already previously proved conclusively that a solution of ordinary well-made bleaching-powder contains almost exactly 1 equivalent of hypochlorite to 1 of chloride, and has pointed to the corroborative fact that, if one allows a certain volume of chlorine to be absorbed by lime, the whole of this is set free again by the addition of an acid, whilst, if Calvert's opinion were correct, only two-thirds would be set free. Kolb seeks the cause of the discrepancy between Calvert's results, on the one hand, and his own, and the opinions generally held by chemists, on the other hand, in the analytical method employed by Calvert, wtth which Kolb disagrees *in toto*. Kolb points to the fact that, on boiling a solution of hypochlorous acid in the presence of recently precipitated calcium carbonate, a portion of the latter is converted into chloride. This causes the percentage of hypochlorite to appear smaller, and that of chloride larger than it is in reality. Another source of error is this:—that caustic lime is somewhat soluble in calcium chloride, and thus vitiates the estimation founded upon the weighing of the residue. He also demurs to Calvert's treating bleaching-powder with

absolute alcohol in order to separate calcium hypochlorite and chlorides; he states that on repeating the experiment he could find only traces of hypochlorite on the filter, which is nothing to be wondered at, as it seems hardly likely that alcohol could be brought into contact with such a strong oxidising agent as bleaching-powder without acting upon it, even up to the formation of chloroform. In any case a great deal of the hypochlorite must be converted into chloride and thus vitiate the result.

Kolb's own analytical method is as follows. He adds to a filtered solution of bleaching-powder ammonia, first in the cold, then heats to the boiling-point; thus the hypochlorite is converted into chloride, and the total chlorine is then estimated by silver solution. In another portion of the filtered solution the chlorine of the hypochlorites is estimated by Gay-Lussac's volumetric method. The total lime and other constituents are estimated by the ordinary methods in another sample of bleaching-powder, first treated with ammonia, in order to destroy the hypochlorites. He thus finds the proportions as stated above; on representing the analysis according to Calvert's method, he finds a result similar to that found by Calvert, but, of course, totally rejects it as being obtained by a faulty method.

Mr. Clapham said, with regard to the causes of the loss of sodium in the alkali-making process, there was no analysis given of the limestones which were used. It gave the different quantities of limestone used, but it did not give the analysis. They were left in the dark as to the purity or otherwise of the limestones which were employed. This appeared to be one feature which should be cleared up. But again, it goes no further than the simple experiment as to the effect of the limestone. It did not give any further information as to the other causes of loss in the ball process. It was very well known that they did lose sodium or soda in the balling process: but it did not go further than the simple fact that, in the case of limestone of a certain quality, no loss of sodium or soda takes place. He did not know whether any information could be given on this point of the analysis of the limestone.

The President said he had better remark at once, in answer to Mr. Clapham's observation, that in the original paper there was no analysis given of the limestone used in this process. As he did not see present the gentleman who mentioned this matter to him, he would observe that a similar observation had been made in a very large factory on the Tyne, where they used the same material as all other manufactories, viz., the London chalk. There are two large branch works at that factory; and in one of them they had been using a very much larger proportion of chalk than in the other; and at the end of the manufacturing year it was found that in that branch of the works where they had been using the excess of limestone their yield was very much smaller than in the other works. That was found out without any bias in favour of one or the other, as a matter of fact, and the gentleman in question mentioned it to him as bearing out M. Scheurer-Kestner's paper. Of course, it was very well known that there were a great many other sources of loss of soda in the balling process; but this paper only dealt with this individual source, and he believed made it somewhat clearer than it used to be. He believed that formerly this source of loss had been very much overlooked. The author had also dealt with the assumption pretty generally made before, that a great deal of the loss is caused by the volatilisation of soda, and he refuted the assumption that there is any loss, or at any rate any appreciable loss, caused by the sodium being reduced to the metallic state and volatilised; and he (the President) believed most chemists would agree with him upon this point. But he did not deal with one source of loss which he (the President) believed in some cases was very considerable, that was the mechanical carrrying away of part of the soda mixture; and he thought that between the two, the soda-ash left in the tank waste and the portion of the mixture mechanically carried away, most of the soda in the ball mixture would be accounted for, of course not all as available carbonate of soda, but a great portion of it as sulphate. But certainly nothing was more desirable than that those causes of loss should be known; for, if once well understood, it was very likely that the loss itself would be greatly lessened.

Mr. Clapham said, so far as the mechanical loss was concerned, there could be no doubt that that was considerable. He himself had tried an experiment some years ago as to preventing it. A considerable portion of that mechanical loss in the ball furnace was found afterwards as deposit in the evaporating pan, in the form of additional sulphate of soda; but, even after it had passed over the whole length of the pan, there was a considerable quantity passed into the flues, and, as a rule, he had found, after frequent trials of the deposit in those flues, that it consisted almost entirely of sulphate of soda. But, to prevent that, he contrived a damper, which shut off the draught from the furnace to the pan at the time when the fire-door for charging the furnace was open. That was done by attaching a chain to the door of the furnace. When the man opened the door of the furnace he naturally put the damper down, and at the same time it necessitated him, to prevent the place being filled with smoke and other matters, to open the damper into the main flue; in this way, impurities were prevented from going into the pan. He found that answered very well. Without that arrangement for the alteration of the damper, when there was no positive necessity, the workmen of course shirked the matter, and it was never done. But, by fastening it in such a way that when the door was opened, the damper connected with the pan went down, this loss or injury was avoided, and the sulphate of soda which was carried away by a draught could be collected afterwards in that depositing flue. This was one source of loss. But, in addition to the mechanical losses, there were chemical losses. There was no doubt in his mind that a very large portion of the loss which was sustained in the form of soda was owing to the impurity of materials used, especially if either the limestone or the clay contained much iron. The oxide of iron which the iron forms, the insoluble sulphates, combines very easily with the soda; and was one of the sources, at any rate, in addition to the limestone. Therefore, so far as he could ascertain, there appeared to be a greater loss of soda whenever the materials contained very much iron. He had tried that, and could speak to that fact.

Mr. W. C. Reid said that, in connection with this note on bleaching-powder, he might mention that in Deacon's new operation the chlorine was much more permanent than in the old one; and it seemed to show that at least a portion of the chlorine, when produced under pressure, seemed to be held mechanically by the lime. It had not the same smell as the bleaching-powder produced by the old process. He had met Dr. Crace Calvert at Mr. Deacon's one time; and he suggested that in the old process part of the manganese was carried over, and was the cause of the chlorine being given off. He (Mr. Reid) did not know whether that was so or not, but it seemed to bear rather upon the question to know that in Deacon's, where the gas is not passed over the lime under pressure, the chlorine is more stable, and there is not the same loss by exposure to the air, even if brought up to 36 or 37 per cent.

Mr. Clapham said, in connection with Deacon's process, there appeared to be no reason why they should not have adopted years ago the plan of drawing the gases through the bleaching-powder, instead of forcing them in with great difficulty, very considerable loss, and annoyance to the neighbourhood in which these works were situated. As Mr. Reid had been kind enough to refer to Deacon's process, and as he had had a good deal of practice with it, he would like to ask him whether he had found there was any appreciable volatilisation of the chloride of copper on the small marbles through which the chlorine passes.

Mr. Reid said there was very little on the top of the

marbles in the first compartment: that was the only place where they had found it yet; they had not found any in the pipes—not a trace. They had found it only in one or two of the compartments near the commencement. There was a little chloride of copper left on the surface there—not more than a few grains.

CORRESPONDENCE.

THE SODA PROCESS, AND PROPOSED IMPROVEMENTS.

To the Editor of the Chemical News.

Sir,—Referring to the concluding part of Mr. Hill's paper (Chemical News, vol. xxvii., p. 163), I beg to state that the "loss of sulphurous acid" by my process is not by any means "inevitable," as it is quite practicable to work with much less loss than is practicable in the old process, and it is quite possible to work without any loss whatever, and even burn a part of the evolved hydrochloric acid into chlorine and water.

As to the "tediousness" of the process, the salt does not require to be handled at all while in the converting-chambers, the labour in this part of the work consisting solely in putting the salt into the chambers and drawing out the finished sulphate.

The fuel required to make a ton of sulphate is not more than a third part of that required by the sulphuric acid process of making sulphate, as the gases are passed directly from the burners at a red heat, and the heat developed by the reaction of the sulphurous acid upon the salt also assists in maintaining the temperature. In fact, there is theoretically more heat developed than is requisite to maintain the temperature of the materials under the operation at the proper point, and fuel is used not so much to *heat* the materials as to provide a layer of heated gas to prevent loss of heat by radiation, and with every enlargement of the apparatus the consumption of fuel becomes less and less with the reduction of the proportions of radiating surface to the cubical contents of the chambers. No nitrate of soda is required in the process, and thus a very costly item in the manufacture of sulphate of soda is removed. Powdered rock-salt can also be employed, as well as white salt, which reduces the cost of the raw materials. The temperatures at which the materials are to be maintained do not exceed from 800° to 900° F., and there are therefore no high temperatures to cause the rapid destruction of the apparatus, and the wear and tear is quite inappreciable.

I shall be happy to satisfy Mr. Hill as to the correctness of the foregoing statements, by showing to him the process in operation, if he will pay me a visit.—I am, &c.,

James Hargreaves.

Atlas Chemical Works, Widnes,
April 8th, 1873.

TIN ORE.

To the Editor of the Chemical News.

Sir,—I think your correspondent "J. W." will find the following method, which I devised some twenty years ago, serve his purpose for the rapid estimation of tin in tin ore (*i.e.* native protoxide):—Finely powder in the agate mortar some 20 to 25 grains of the perfectly dry ore; place this into a small test-tube and weigh. Fuse about four times this weight of cyanide of potassium in a small and rather deep porcelain capsule over a Bunsen burner; when in calm fusion and quite red-hot remove the flame and project the ore into this. Now weigh back the tube difference equal weight of ore employed; replace the gas flame and keep in quick fusion for 15 or 20 minutes, by which time the oxides of tin and iron will be reduced to the metallic state, and lie as a sponge at the bottom of the capsule: pour the whole contents on to an iron plate, and when cold the mass will leave the iron. Put cake and capsule into a basin, and add water to dissolve the cyanate and excess of cyanide; carefully decant, and when sufficiently washed free from these salts, add HCl; the metal will dissolve, and after solution pour the whole and wash the capsule into a beaker; add metallic zinc until the last piece ceases to show a precipitate of tin. Break up the sponge with a rod, dilute, and when settled, carefully pour off the ZnCl, and wash until the tin is pure; again dissolve in HCl, dilute, and estimate tin by a standard solution of bichromate of potash, using IK and starch water. In my original method, published in the *Chemist* for May, 1853, I simply dissolved the metals as reduced by the cyanide in HCl, and estimated the tin by a solution of Fe_2Cl_3. The metals may be reduced by a stream of dry H, but with comparatively little advantage. I have done scores of estimations of tin in the ore by the methods here given. Little more than an hour is required for a determination.

I may here add by way of parenthesis that the mode of estimating tin by means of a solution of bichromate, and generally known as Dr. Penny's process, was in daily use in his laboratory at the beginning of 1850, several years before the date of Dr. Penny's paper, and was devised by Mr. Dale, now of the firm of Roberts, Dale, and Co., of this town.—I am, &c.,

Peter Hart.

Ardwick Bridge Chemical Works,
Manchester.

MISCELLANEOUS.

Utilising Suint for the Manufacture of Prussiate of Potash.—The suint, which forms almost the third part in weight of the raw wool, has been found to be an excellent material for the manufacture of yellow prussiate of potash, which is used for making prussian-blue and other articles of commerce, inasmuch as, after heating, it consists of an intimate mixture of carbonate of potash and nitrogenous carbon. Formerly this suint was exclusively used for the production of potash. Havrez found, however, that it is three times as valuable when directly used for the manufacture of prussiate of potash. While 100 kilogrms. of dry suint, containing 40 kilogrms. pure potash, cost only 3 dols., 100 kilogrms. of the potash of commerce cost from 14 to 16 dols. Thus it will be seen that, by employing the suint, 100 kilogrms. of potash may be obtained for 7·50 dols.

The Verifications of Physical Theory occur in the world of sense. Laying the theoretic conception at the root of matters, we determine by rigid deduction what are the phenomena which must of necessity grow out of this root: If the phenomena thus deduced agree with those of the actual world, it is a presumption in favour of the theory. If, as new classes of phenomena arise, they also are found to harmonise with theoretic deduction, the presumption becomes still stronger. If, finally, the theory confers prophetic vision upon the investigator, enabling him to predict the existence of phenomena which have never yet been seen, and if those predictions be found on trial to be rigidly correct, the persuasion of the truth of the theory becomes overpowering.—*Prof. Tyndall.*

Are not the Elements Molecules?—One of the tenets of the modern atomic theory, viz., that no compound can exist where the valences of its component elements are not all satisfied, is universally acceded to by writers on chemistry; but, in the very face of this statement, they nearly all rush into what appears to the writer to be a rank absurdity and inconsistency, and perhaps on the very next page they will assert that certain elements, for instance, tin, antimony, platinum, &c., are endowed with

the extraordinary faculty of behaving as dyads, triads, tetrads, or pentads, indifferently, according to circumstances. A convenient and full explanation occurs to me, by which this apparent inconsistency may be accounted for. *Imprimis:* To me it appears just as irrational to assert that an element can exist where its valences are not all satisfied as that a compound can. What then becomes of the other two valences of the tetrad tin, in the case of stannous chloride, $SnCl_2$? or of the other two, in the case of antimonious chloride, $SbCl_3$? My answer to these queries is, not that the valences have vanished, but that they are fully active in satisfying those of another similar molecule, or, in other words, the respective formulæ for the above salts are—

$$\begin{matrix} Sn^{IV}\,Cl_2 \\ \| \\ Sn^{IV}\,Cl_2 \end{matrix} \quad \text{and} \quad \begin{matrix} Sb^{V}\,Cl_3 \\ \| \\ Sb^{V}\,Cl_3. \end{matrix}$$

And now for the deduction from the following facts:—If antimony be dissolved in HCl, the trichloride, $SbCl_3$, is only obtained, and in the case of tin, the bichloride, $SnCl_2$, whereas, by projecting powdered Sb into chlorine gas, the pentachloride, or, of tin, the tetrachloride, is obtained. My deduction is that tin, antimony, or any other element, as a single atom, cannot exist, but that every atom, in the uncombined state, is bound by all its valences to one of its own number. Antimony, then, is—

$$\begin{matrix} Sb^{V} \\ \| \\ Sb^{V}, \end{matrix}$$

and when acted on by HCl, where the negative affinity of the Cl is in a measure masked by the H, it is only capable of separating three of the Sb valences, and—

$$\begin{matrix} Sb\,Cl_3 \\ \| \\ Sb\,Cl_3 \end{matrix}$$

results. Project antimony, on the other hand, into Cl gas, and now the powerful negative affinity of the Cl, not being diluted by the H, is capable of cutting apart all five of the antimony valences, and $SbCl_5$ is obtained. The same is true of tin, and, in fact, instances might be added *ad infinitum*; but is not the above sufficient? My conclusion, then, is, that the elements are constant in their saturating power, and under all circumstances are endowed with the maximum number of valences which they show under any circumstances.—*Scientific American.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, March 31, 1873.

The Spectrum of Boracic Acid.—Lecoq de Boisbaudran.—The principal bands of boracic acid form one of those systems whose elements approximate to each other to decrease in intensity in proportion as they become more remote from their most brilliant member. The three small red bands of boracic acid can only be connected with the system of the larger bands by means of considerations which I am unable to develop here. The following are the lengths of the undulations measured from the centres of the larger bands. It must be remarked that the centres of bands so large and ill-defined are not easy to measure with great exactitude:—

		1st Diff.	2nd Diff.	3rd Diff.
δ	580·7	—	—	—
α	548·0	32·7	—	—
β	519·2	28·8	3·9	—
γ	494·1	25·5	3·7	0·2
ε	472·1	22·0	3·1	0·6
	452·9	19·2	2·8	0·3
About ..	435·9	17·0	2·2	0·6
				1·7 Mean 0·4

The second differences decrease slowly from the red towards the violet with a mean diminution of 0·4 from one term to another. If, accepting the constancy of the third differences, we adopt as the best probable measures those of the three most brilliant bands, α, β, and γ, the second difference will preserve the value 3·7, and the rectified position of the other bands will become:—

	Measured.		Calculated from α, β, and γ. 1st Diff.	2nd Diff.	3rd Diff.
δ ..	580·7	580·9	—	—	—
α ..	548·0	548·0	32·9	—	—
β ..	519·2	519·2	28·8	4·1	—
γ ..	494·1	494·1	25·1	3·7	0·4
ε ..	472·1	472·3	21·8	3·3	0·4
	452·9	453·4	19·9	2·9	0·4
	435·9	437·0	16·4	2·5	0·4

We may perhaps feel surprised to see that the band δ possesses much less intensity than α, more advanced in the system. This fact, though contrary to the general rule, is not rare; in such cases, setting out from the second band, the intensity diminishes almost regularly to the feeble margin of the system. The maximum intensity is still more rarely in the third band. I may mention the electric spectra of metallic aluminium, and of manganic chloride as examples of these peculiarities. I wish to call the attention of chemists to the advantage derived from the addition of a few drops of hydrochloric to the liquids on which the induction light is thrown in searching for boracic acid. Thus, when a solution of boracic acid in hot water under the action of the spark gave only a feeble spectrum, the addition of a trace of hydrochloric acid rendered it immediately brilliant, containing the same bands as those shown of a gas-flame, but larger. The enlargement is chiefly on the left margin of the bands towards the red.

On the Alcohol and Acetic Acid Normally Present in Milk, as Products of the Action of Microzymas.—M. A. Bechamp.—The object of this paper is to prove that the milk of cows, from the moment when drawn, contains really acetic acid and alcohol, and secondary, that the same cause continuing to act during and subsequent to fermentation, these products increase in the curdled milk. Fresh milk is mixed with a slight excess of oxalic acid, and at once submitted to distillation in a chloride of calcium bath, the temperature of which is kept at 120° C. to prevent the formation of incidental products. In this operation the formation of foam is the chief difficulty. 19-20ths of the milk are distilled over. The clear liquid has always an acid reaction. Excess of pure carbonate of soda is added, and rather more that a tenth part is collected, which is concentrated by distillation and rectification over carbonate of potash. The alcohol is known as such by its inflammability, by its products when oxidised with a mixture of bichromate of potash and sulphuric acid, by the formation of crystalline acetate of soda, and by the formation and analysis of acetate of silver. The acetic has been separated from the sodic residues from which the alcohol had been withdrawn. Milk spontaneously coagulated by exposure to the air yielded also alcohol and acetic acid. In this case, it was important to search for butyric acid or its homologues, products of the alteration of albumenoid matters; none could be found. It became interesting to seek alcohol and volatile acids in the milk coagulated in the stomachs of lambs. Here alcohol and acetic acid were found, along with a little caproic acid. Asses' milk yields also alcohol and acetic acid; which may, therefore, be inferred to exist in the milk of all Herbivora. In that of the Carnivora it has yet to be sought. A litre of cows' milk yielded 0·224 grm. of alcohol, expressed as acetic acid. In another case, the quantity was only 0·036 grm. In the milk found in the stomachs of lambs, the mycrozymas were accompanied by a great number of bacteria, a fact of importance. The author considers that alcohol and acetic acid are produced in the mammary glands by the action of the microzymas on the glucogenous matters of the milk. All microzymas appear to have this power, not merely with sugar, but with the acids of fruits. The author pronounces Liebig's doctrine of the alterability of the albumenoids in the phenomena of fermentation a serious error. He has already proved that in the fermentation of eggs the albumen remains unaltered. He announces that he will produce proofs that, when milk becomes sour, the casein and other albumenoid matter retain their essential properties unaltered. He has found that the rotatory power of casein is quadruple that of albumen. The casein of curdled, and that of recent milk, have the same rotatory power.

La Revue Scientifique de la France et de l'Etranger, March 29, 1873.

Contains nothing original relating to chemistry, but attention is called to—

Géodésie Francaise Depuis Deux Siècles.—E. Alglave.—An important contribution to ordnance surveys.

Bibliography.—"Traité de Climatologie Générale du Globe," par le Docteur Armand; Paris: G. Masson. "Guide Pratique du Fabri-

cant de Sucre," par N. Basset; 3 vols; Paris, 1873. This work is here stated to contain the most complete and recent matter, theoretical as well as practical, relating to the sugar-production industry.

Les Mondes, March 13, March 27, and April 3, 1873.

These numbers contain no original papers relating to chemistry.

Revue Hebdomadaire de Chimie Scientifique et Industielle, February 9, 1873.

Concentration of Sulphuric Acid (Hemptinne's Process.—From the contents of this paper it appears that the vacuum pan process of concentrating the acid is more commercially advantageous than the employment of platinum vessels.

American Journal of Pharmacy, March, 1873.

In addition to several original papers strictly relating to pharmaceutical science this number contains the following original matter relating to chemistry:—

New Reaction for Carbolic Acid.—C. Rice.—Into a 5-inch test-tube put about 10 grs. of previously powdered chlorate of potassa, pour upon it strong hydrochloric acid to the depth of 1 inch, and allow the action of the gas to proceed for about 1 minute, then dilute with 1½ volumes of water, and remove the gas contained in the upper part of the test-tube by blowing the gas out by the aid of a bent tube. It is advisable not to omit this precaution since, otherwise, the subsequent addition of ammonia is frequently accompanied by a vivid flash of light. Pour next upon the liquid contained in the test-tube solution of ammonia to the depth of about half an inch, and remove the white clouds of chloride of ammonium by blowing gently through a glass tube as before. Now add a few drops of the liquid suspected to contain carbolic acid by pouring it down the sides of the tube. If any carbolic acid be present, the upper (previously colourless ammoniacal layer) will assume a colour varying, according to the quantity of carbolic acid present, from the darkest brown to red brown, blood red, and rose red. The colour appears first, either at the top when much acid is present, or below at the point of contact of the two layers of liquid when the quantity of carbolic acid is small in the form of a colour 1 part of carbolic acid in 12,000 may be distinguished. The same reaction is produced with creosote (Reichenbach's ?), but no other substance gave this reaction

Improved Atmospheric Washing-Bottle.—W. J. Land.—Illustrated by a woodcut. This instrument consists of a washing-bottle to the neck of which is laterally soldered a glass tube, to which is tightly fitted a vulcanised india-rubber syringe bulb. The glass jet-tube passes in the usual manner through the india-rubber stopper or cork, and the water is forced through the jet by pressing the syringe bulb, the pressure ceasing, air enters through the jet-tube and fills the syringe-bulb again.

Artificial Ivory.—W. A. Welling.—The article alluded to is composed of 10 ozs. of white shellac, 4½ ozs. of acetate of lead, 8 ozs. of ivory dust, and 5 ozs. of camphor. These ingredients are first reduced to powder, then heated and mixed, then pressed in heated moulds or formed into sheets, &c.

Gazzetta Chimica Italiana, Nos. 1 and 2 (double number), 1873.

Contains the following original papers and memoirs:—

Alleged Emission of Ozone from Plants.—Dr. G. Bellucci.—This monograph treats exhaustively on a question first raised by Dr. Scoutetten at Metz in 1856, who then stated that the oxygen evolved from plants under the influence of the direct sunlight is ozone. This opinion was in the same year proved to be erroneous by Cloez, and has since been frequently discussed, some authors holding with Scoutetten, others with the last-named *savant*. Dr. Bellucci gives in this essay a *resume* of all the results of the labours of different authors, and next records the results of his experiments on the evolution of oxygen from plants (including water plants), and on the nature of this gas, which is stated not to be ozone. The ingenious mode of experimenting is described *in extenso*.

Normal Butylic Compounds and on Valeric Ether.—A. Lieben and A. Rossi.—From a foot-note appended to this essay it appears that its contents were published nearly 2 years ago in the *Ber. d. Deutsch. Chem. Gesells.*, from which it was quoted in the CHEMICAL NEWS.

On a Reddish-Coloured Vulcanised India-Rubber.—G. Dalsie.—This paper treats on the composition and colouring matter met with in some kinds of Perry's elastic bands which have been submitted to analysis by the author, who seems to be unaware that, while he finds antimony in the material, one of the sulphurets of that metal is now and then applied with other materials as a so-called vulcanising material.

Analysis of a Sulphuretted Water from the Source known as Santa Venera di Pozzo, Situated at the Eastern Foot of the Etna.—O. Silvestri.—The composition of this water is chiefly of local interest.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 244, April, 1873.

Contains no original papers relating to chemistry.

NOTES AND QUERIES.

Separation of Woollen from Cotton Fibre.—It is necessary in many cases to separate woollen warps or wefts from cotton wefts or warps. Will any of your readers be so kind as to state which process has worked most economically and satisfactorily for separating either of the before-mentioned fibres from the other?—SUBSCRIBER.

Aniline Inks.—It ought to be known that, as a rule, these inks are the least permanent of any in common use. Still, further, in view of recent great conflagrations, it is to be noted that no inks have been so generally destroyed, where used on books or paper subsequently charred in fireproof safes, as the various aniline inks. Mr. C. Gilbert Wheeler says, in the *Scientific American*, that a very extensive experience in restoring charred paper in the Chicago, and now in the Boston, fire, has convinced him that these inks, as a class, are beyond the power of the chemist to restore to legibility when exposed to a high temperature.

PATENTS.

Communicated by Messrs. VAUGHAN and SON, Patent Agents, 54, Chancery Lane, London, W.C., and 8, Houndgate, Darlington.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

326. G. Haseltine, Southampton Buildings, London, "An improved process of converting cast-iron into steel, applicable to the manufacture of edge-tools."—A communication from T. H. Alexander, Washington, D.C., U.S.A.—Petition recorded January 28, 1873.

476. R. Werdermann, Princes Street, Surrey, "An improved mode of, and apparatus for, purifying and refining metals and alloys."—Petition recorded February 10, 1873.

926. E. A. L. Roberts, Titusville, Penn., U.S.A., "Improvements in treating explosive compounds to impart safety thereto for blasting and other purposes."

931. E. Bevan, Birkenhead, and T. Drew, Tranmere, Cheshire, "Improvements in the treatment of vegetable substances to obtain paper-pulp and fibres."

945. A. M. Clark, Chancery Lane, Middlesex, "Improvements in the treatment of peat for fuel, and in apparatus for the same."—A communication from J. F. F. Challeton, Paris.—Petitions recorded March 14, 1873.

957. J. Robey, Manchester, and G. F. Chantrell, Liverpool, "A new or improved filtering and deodorising medium."

963. H. Gardner, Holloway, Middlesex, "Improvements in apparatus and means for utilising spirituous substances and oils for the purposes of producing artificial light and heat."—Petition recorded March 15, 1873.

990. A. Barclay, Kilmarnock, N.B., "Improvements in the manufacture of pig-iron, and in furnaces or apparatus employed therefor."—Petition recorded March 18, 1873.

1044. E. E. Pearse, New Wandsworth, Surrey, "Improvements in the manufacture of glucose or grape sugar from rice and other grain, and in apparatus employed therein."

1046. J. Baggs, High Holborn, Middlesex, "Improvements in the manufacture of gas for illuminating and other purposes."—Petitions recorded March 20, 1873.

NOTICES TO PROCEED.

3,762. L. Banks, Kingston-upon-Hull, "Improvements in the manufacture or composition of fuel."—Petition recorded November 12, 1872.

3417. F. Hahn, Berlin, "Improvements in the manufacture of steel and malleable iron, and in furnaces therefor."

3421. T. Bagley, Birmingham, "A new or improved varnish."—Petitions recorded November 16, 1872.

3464. E. Hills, Warsash, Hants, and B. Biggs, Laurence Pountney Hill, London, "Improvements in deodorising and purifying sewage and other excrementitious matters, and in obtaining certain useful products therefrom."—Petition recorded November 20, 1872.

551. D. Hutchison, Mile End, and W. G. Bridges, Stepney, Middlesex, "An improved composition for removing and preventing incrustation in boilers."—Petition recorded February 14, 1873.

743. R. K. Whitehead, Walmersley, near Bury, Lancashire, "Improvements in the manufacture of size."

744. T. Cadett, Rosherville, Kent, "An improved artificial fuel."—Petitions recorded February 28, 1873.

823. W. Wright, Sheffield, "Improvements in the manufacture of gas for heating and illuminating purposes, and in apparatus for the same, parts of which are applicable to other purposes."

828. J. Hargreaves and T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of sulphates of soda and of potassa, and in the production of chlorine."—Petitions recorded March 7, 1873.

PATENTS SEALED.

2913. H. B. Barnett and W. B. M. Slade, Gracechurch Street, London, "Improvements in the preparation or production of disinfecting, antiseptic, and cleansing liquids."—Dated October 3, 1872.

2934. H. B. Barnett and W. B. M. Slade, Gracechurch Street, London, "Improved manufacture of fluids for deodorising and disinfecting purposes."—Dated October 4, 1872.

3525. J. Mitchell, Westminster, "A new or improved cretaceous hydrocarbon fuel."—Dated November 25, 1872.

335. J. A. H. Toulson and T. Harmer, Leeds, Yorkshire, "Improvements in the means employed for freeing glass from carbon,

grease, or other substances that may adhere to its surface."—Dated January 28, 1873.

303. J. McDougall, Manchester, "Improvements in the manufacture of manures."—Dated February 1, 1873.

MEETINGS FOR THE WEEK.

TUESDAY, 15th.—Civil Engineers, 8.
WEDNESDAY, 16th.—Meteorological, 7.
—— Society of Arts, 8.
THURSDAY, 17th.—Zoological, 4.
—— Chemical, 8.

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THE CHEMICAL NEWS.

Vol. XXVII. No. 699.

ON THE

RADIATION OF HEAT FROM THE MOON, THE LAW OF ITS ABSORPTION BY OUR ATMOSPHERE, AND ITS VARIATION IN AMOUNT WITH HER PHASES.*

By the EARL OF ROSSE, D.C.L., F.R.S., &c.

In this paper is given an account of a series of observations made in the Observatory of Birr Castle, in further prosecution of a shorter and less carefully conducted investigation, as regards many details, which forms the subject of two former communications† to the Royal Society.

The observations were first corrected for change of the moon's distance from the place of observation and change of phase during the continuance of each night's work, and thus a curve, whose ordinates represented the scale-readings (corrected) and whose abscissæ represented the corresponding altitudes, was obtained for each night's work. By combining all these, a single curve and table for reducing all the observations to the same zenith-distance was obtained, which proved to be nearly, but not quite, the same as that found by Prof. Seidel for the light of the stars. By employing the table thus deduced, and also reducing the heat-determinations obtained on the various nights for change of distance of the sun, a more accurate phase-curve was deduced, indicating a more rapid increase of the radiant heat on approaching full moon than was given by the formula previously employed, but still not so much as Prof. Zöllner's gives for the moon's light.

By employing Laplace's formula for the extinction of light in our atmosphere, the heat-effect in terms of the scale-readings was deduced, and an approximation to the height of the atmosphere attempted.

From a series of simultaneous measurements of the moon's heat and light at intervals during the partial eclipse of November 14, 1872, when clouds did not interfere, it was found that the heat and light diminish nearly if not quite proportionally, the minimum for both occurring at or very near the middle of the eclipse, when they were reduced to about half what they were before and after contact with the penumbra.

NOTE ON THE

SYNTHESIS OF MARSH-GAS AND FORMIC ACID, AND ON THE ELECTRIC DECOMPOSITION OF CARBONIC OXIDE.‡

By Sir B. C. BRODIE, Bart., D.C.L., F.R.S.,
Late Waynflete Professor of Chemistry in the University of Oxford.

In connection with the investigation on the electric decomposition of carbonic acid gas referred to in a previous communication to the Society, I was led to submit a mixture of hydrogen and carbonic oxide gas to the action of electricity in the induction tube, the mixed gases being circulated through the tube by means of an apparatus which I will not now describe. A contraction was soon observed to have taken place, which at the end of an hour amounted to 10 c.c. The rate of contraction steadily diminished, and during the fifth hour of the duration of the experiment amounted to only 2 c.c. The experiment was stopped, and the gas analysed with the following results in two several analyses:—

I.		II.	
Carbonic oxide ..	61·65	Carbonic oxide ..	61·35
Hydrogen	32·16	Hydrogen	32·34
Marsh Gas ..	6·14	Marsh Gas ..	6·31
	100·00		100·00

A small quantity (about 2 per cent) of nitrogen was also contained in the gas, together with a trace of oxygen, which have been omitted from the calculation.

The result of this reaction is expressed in the following equation:—$CO+3H_2=CH_4+H_2O$.

This fundamental experiment, which constitutes the basis of a new method of chemical synthesis, susceptible of the most varied applications, and of peculiar interest in reference to the explication of natural phenomena, was commenced by me on the 10th of January last, at Oxford, in the laboratory of my friend and successor in the Chair of Chemistry, Professor Odling; and two analyses of the gas were completed, and the results attained in the course of a week from that date.

In a similar experiment made with a mixture of hydrogen and carbonic acid gas, a contraction also occurred, attended with the formation of water. The gas which resulted from the experiment was found to consist (after the absorption of carbonic acid) of hydrogen and carbonic oxide, together with a little marsh-gas. Traces of oxygen and nitrogen were also present. Minute drops, too, of an oily liquid appeared in the tube. This liquid, after the conclusion of the experiment, was dissolved in a small quantity of water. The solution was strongly acid and had a pungent taste. It reduced an alkaline solution of terchloride of gold and an ammoniacal solution of nitrate of silver. These reactions are the characteristic properties of formic acid, of which we may infer the synthesis to have been effected according to the equation—

$$H_2+CO_2=H_2CO_2.$$

I may avail myself of the present opportunity to place on record the following important facts in reference to the action of electricity on carbonic oxide gas.

When pure and dry carbonic oxide is circulated through the induction-tube, and there submitted to the action of electricity, a decomposition of the gas occurs, attended with a gradual and regular contraction, which in the form assumed in my experiments, occurred at the regular rate of about 5 c.c. in an hour. Carbonic acid is formed, and simultaneously with its formation a solid deposit may be observed in the induction-tube. This deposit appears as a transparent film of a red-brown colour, lining the walls of the tube. It is perfectly soluble in water, which is strongly coloured by it. The solution has an intensely acid reaction.

The solid deposit in the tube, in the dry condition before it has been in contact with water, is an oxide of carbon. Samples, however, made in different experiments do not present precisely the same composition; but nevertheless they appear to belong to a certain limited number of forms which repeatedly occur, and may invariably be referred to the same general order or system. This system is, or appears to be, what I may term an homologous series of "oxycarbons," of which the unit of carbon with the weight 12 may be regarded as the first term, and of which the adjacent terms differ by an increment of carbonic oxide (CO) weighing 28, precisely as homologous series of hydrocarbons differ by the increment CH_2 with the weight 14. I have succeeded in identifying by analysis two at least of these substances, namely the adjacent terms C_4O_3 and C_5O_4. From this point of view these peculiar bodies are members of a series of oxycarbons analogous in the oxycarbon system to the series of hydro-

* Abstract of the Bakerian Lecture, delivered before the Royal Society, March 27.

† *Proceedings of the Royal Society*, vol. xvii., p. 436; vol. xix., p. 9.

‡ Read before the Royal Society, April 3.

carbons of which the unit of carbon is the first and the unit of acetylene, C_2H_2, is the second term, the oxycarbon C_4O_3 being represented in that series by the hydrocarbon crotonylene, C_4H_6, and the oxycarbon C_5O_4 by the hydrocarbon valerylene, C_5H_8.

ON AN AIR BATTERY.*

By J. H. GLADSTONE, Ph.D., F.R.S., and ALFRED TRIBE, F.C.S.

The galvanic battery which we are about to describe is founded on a reaction that we brought under the notice of the Royal Society last spring.† We then showed that if pieces of copper and silver in contact are immersed in a solution of nitrate of copper in the presence of oxygen, a decomposition of the salt ensues, with the formation of cuprous oxide on the silver and a corresponding solution of the copper, while a galvanic current passes through the liquid from copper to silver. We stated, moreover, that this was no isolated phenomenon, but only one of a large class of similar reactions. It seemed desirable to examine more fully the history and the capabilities of the electrical power thus produced.

It was previously ascertained that the combination of the oxygen takes place only in the neighbourhood of the silver; and the following formulæ may serve to render the chemical change and transference more intelligible:—

Before contact—

$$m\mathrm{Ag} + \mathrm{O} + \mathrm{Cu2NO_3} + \mathrm{Cu2NO_3} + n\mathrm{Cu};$$

after contact—

$$m\mathrm{Ag} + \mathrm{Cu_2O} + \mathrm{Cu2NO_3} + \mathrm{Cu2NO_3} + (n-2)\mathrm{Cu}.$$

This action is evidently a continuous one until either the oxygen or the copper fails.

Now the oxygen of the atmosphere is practically unlimited in amount, but there is a difficulty in bringing any large quantity of it into contact at once with the silver and the dissolved salt.

To facilitate this, we arrange that the silver plate should have a horizontal position just under the surface of the liquid in the cell; and, in fact, we convert it into a small silver tray full of crystals of the same metal, which rise in projections to the very surface. The copper plate lies horizontally under it, separated, if need be, by a piece of muslin, and connection is made by a wire as usual. The vertical part of the copper plate, from a little above the liquid to the bend, should be varnished; otherwise solution principally takes place there, which causes the horizontal part of the plate to drop off. Holes are made in the silver tray with the view of shortening the communication between the air-surface and the copper plate and of facilitating the movements of the salt in solution. The solution itself may be contained in a shallow trough or saucer.

That dissolved oxygen is absolutely necessary for this chemical change has been already shown; but it was interesting to measure by a galvanometer the difference of the currents obtained by means of an ordinary, that is aërated, solution of copper nitrate, and one from which the air had been separated to the greatest possible extent. A Thomson's galvanometer was employed, which had a resistance of 2631·5 units at 18·3° C. Two cells were prepared with vertical plates and alike in all respects, except that the one contained an ordinary 6 per cent solution of copper nitrare, and the other a similar solution which had been deoxygenised by the means described in our former paper. Another experiment was made with a different pair of cells and an 11 per cent solution. It was necessary to use the 1-99 shunt; and the following were the amounts of deflection:—

Time after immersion.	Expt. I.		Expt. II.	
	Oxygenised.	Deoxygenised.	Oxygenised.	Deoxygenised.
1 minute.	78	14	130	11
4 minutes.	72	9	90	8
12 ,,	68	6	75	6
49 ,,	—	—	58	3·5

The contrast is evident. That the deoxygenised solution does give a deflection at all is due partly to the difficulty of excluding air, and partly, perhaps, at first to the oxygen condensed on the surface of the silver plate. The effect due to the water itself is inappreciable.

From the nature of the reaction it might be expected that the current would gradually diminish on account of the using up of the dissolved oxygen in the neighbourhood of the silver; such a diminution always does take place, at least after the first few vibrations of the needle.

It might be expected, too, that when the amount of action has run down considerably, the mere moving of the liquid so as to bring fresh parts of the solution against the silver would augment the currents. It does so.

The same might be predicted from stirring up the crystals of silver in the tray so as to expose new surfaces. This also was found to be the case.

And, again, it might be anticipated that if the wire were disconnected for a time so as to allow the oxygen to diffuse itself from other parts of the solution, and the connection were made, the current would be found as strong, or nearly so, as before. That also is true in fact.

A cell with the plates connected by a wire was placed under a bell-jar full of air over mercury. The mercury gradually rose inside, as might be expected from the absorption of the oxygen in the air.

The necessity of oxygen and the avidity with which it is taken up are both illustrated by the following experiment:—Two cells with horizontal plates were prepared alike in every respect, except that the first was filled with a solution simply deprived of oxygen, the second with a solution through which a stream of carbonic acid gas had been passed for some time. The first was placed in the air, the second in a vessel from which the air had been expelled by allowing carbonic acid gas to flow into it for an hour or two.

The deflections obtained were as follows, the 1 99 shunt being used and the temperature being 13·7° C.:—

Time after immersion.	In air.	In CO_2.
1 minute.	165	76
5 minutes.	135	62
10 ,,	135	58

As the cell in an atmosphere of carbonic acid gas showed considerable action, in fact nearly half as much as that in the air, each cell was short circuited for twenty-three hours, with the expectation that any oxygen in the closed vessel would be used up; and, indeed, the most prominent crystals of silver in the cell in carbonic acid gas became reddened, while a cuprous deposit extended over the whole of the crystals in the other cell. When, however, the short wires were removed and the galvanometer interposed, the cell in the air gave a deflection of 136, practically the same as before, but that in carbonic acid gas, instead of showing a great decrease, rose to 80. It was then found that the vessel containing the latter slowly admitted air; so the contents were swept out by a fresh stream of carbonic acid gas, and it was made properly air-tight. After connection by a short wire for three days the galvanometer indicated a deflection of 20, that of the cell in the air being 110, temperature 10° C. As this showed a very great reduction of the chemical action, carbonic acid gas was again passed through the vessel for an hour or two; and after a connection of two more days the indication of the galvanometer was only 3, while the other cell gave 115, the temperature being now 10·5° C. The action, therefore, was at last reduced almost to nothing; and the original fault in the experiment brought out, perhaps more clearly than would otherwise

* Read before the Royal Society, April 3.

† *Proc. Roy. Soc.*, April, 1872, vol. xx., p. 290.

be seen, how eagerly the solution will absorb even minute quantities of oxygen from the surrounding gas.

An important point to determine was the best strength of the copper nitrate solution. Six per cent was generally preferred, for two reasons:—first, it gives about the maximum of effect—a solution four times as strong gives less than half the deflection, and a solution only a quarter as strong gives only two-thirds; secondly, a stronger solution than this 6 per cent is apt to produce a deposit, not of pure cuprous oxide, but of a subnitrate, which was supposed to clog up the silver crystals to a greater extent.

Another point investigated was the best proportion between the areas of the metallic surfaces. Experiments were made with vertical plates, in which the silver was kept at a uniform size and the copper was diminished by covering it more and more with varnish; and another set was made in which the copper remained the same, while the silver plate was reduced.

The results may be thus exhibited:—

Proportion of surfaces.		Deflection.		
Silver.	Copper.	Expt. I.	Expt. II.	Expt. III.
1	0·25	24	23	—
1	0·50	28	27	—
1	0·75	31	30	—
1	1·00	33	32	28
1	1·33	—	—	28
1	2·00	—	—	32
1	4·00	—	—	30

The increase of the copper surface, therefore, has comparatively little effect.

Proportion of surfaces.		Deflection.		
Copper.	Silver.	Expt. I.	Expt. II.	Expt. III.
1	0·25	—	—	7·5
1	0·50	—	—	16
1	0·75	—	—	21
1	1·00	33	32	28
1	1·33	41	40	—
1	2·00	56	54	—
1	4·00	96	92	—

The increase, therefore, of the silver or negative metal causes an almost proportionate increase in the chemical action. This, doubtless, arises from the necessity of oxygen, and explains the value of the large surface exposed by the silver crystals in the tray.

The effect of heat on the action of this cell was examined; it increases the action greatly: thus an arrangement which gave a deflection of 40 at 20° C. gave one of 250 at 50° C.; and the augmentation was observed to be much more rapid in the higher than in the lower portions of this range of temperature.

If the formula given above for the reaction be a true one, it follows that every atom of copper deposited on the silver in the state of suboxide must be compensated by an atom of copper dissolved from the copper plate. This was proved quantitatively. In a cell that had been in action for a week the loss of the copper plate was 0·391 grm., while the suboxide deposited on the silver was found to be equivalent to 0·398 grm. of metallic copper. This deposit of suboxide, though it soon forms apparently a complete covering to the silver, does not greatly diminish the action; it is probably porous, besides being itself a conductor of electricity. In some cases we have found it deposited in crystals sufficiently large to be seen by the naked eye, and which are shown by a magnifying glass to be regular octahedra.

The internal resistance of this battery, as might be expected, is small.

The electrolytic power of the current was examined. One cell, the plates of which were about 2 inches in diameter, was found sufficient to decompose such metallic salts as the nitrates of copper, silver, or lead, copper sulphate or stannous chloride, in aqueous solution, when platinum was used for the negative electrode, and for the positive the same metal as existed in the salt experimented on. Six cells were sufficient to decompose dilute sulphuric acid slowly and dilute hydrochloric acid pretty quickly, copper electrodes being employed.

The theoretical interest of this battery lies mainly in the fact that it differs essentially from every other galvanic arrangement, inasmuch as the binary compound in solution is incapable of being decomposed either by the positive metal alone or by the two metals in conjunction; it cannot serve, in fact, as the liquid element of the circuit without the presence of another body ready to combine with one of its constituents when set free.

Grove's gas-battery is essentially different from ours if the oxygen and hydrogen condensed on the platinum plates play the part of the two metals; but it closely resembles ours if hydrogen acts the part of the positive and platinum that of the negative metal; the dilute sulphuric acid, a hydrogen compound, will then be decomposed on account of the simultaneous presence of the oxygen, which can combine with the liberated hydrogen. Viewed in this manner, Grove's gas-battery is only a special case of the general reaction which we have described in our previous paper; and the formula will be:—

Before contact, $m\mathrm{Pt}+\mathrm{O}+\mathrm{H_2SO_4}+n\mathrm{H}$; after contact, $m\mathrm{Pt}+\mathrm{H_2O}+\mathrm{H_2SO_4}+(n-2)\mathrm{H}$.

The practical interest of our arrangement lies in the fact that it is an approximation towards a constant air-battery. Should it ever come into use elsewhere than on the lecture table, it will probably be in the form of a combination of zinc and copper, with an aërated solution of zinc chloride; for that arrangement has an electromotive force six times that of the arrangement we have more particularly studied, and about three-quarters that of a Daniell's cell. The numbers representing the difference of potential between the two metals, which were actually obtained by means of an electrometer belonging to Sir William Thomson, were—

Silver and copper with deoxygenised copper nitrate	4
Ditto ditto oxygenised ditto	8 to 11
Copper and zinc with chloride of zinc	62
Ditto ditto water	68
Ditto ditto Daniell's cell	83

Chloride of zinc is preferred to the sulphate, as it offers less internal resistance, and a solution of 20 per cent is recommended as about the best conductor.* A single cell of this description is capable of decomposing dilute sulphuric or hydrochloric acid, when copper electrodes are employed. The two metals might be arranged as in a Daniell's battery; the zinc would of course require no amalgamation, and the whole might be left for weeks or months without any attention. The oxide of zinc produced generally falls to the bottom of the vessel, and may be separated whenever it is thought desirable.

The power is thus obtained at a minimum of expense, for the oxygen which combines with the zinc costs nothing. Such a battery would appear to be specially adapted to cases where the galvanic current has to be frequently broken, as in telegraphy; for at each period of rest it renews its strength by the absorption or diffusion of more oxygen from the air.

ON THE DETECTION OF ARSENIC.

By J. W. GATEHOUSE.

THE following modification of Fleetmann's test, which enables arsenic to be distinguished in the presence of antimony, will be found useful and more delicate than the usual mode of working:—

Place the solution in a long test-tube, and drop in a small piece of caustic soda about the size of a pea, also a piece of aluminium about a quarter of an inch in length by one-eighth of an inch in breadth, and cover the tube

* On the authority of Mr. Herbert MacLeod.

with a piece of filtering-paper which has been moistened with solution of nitrate of silver.

If the soda has not already commenced to act with some degree of energy on the aluminium, warm gently, and set aside for a short time.

The spot of nitrate of silver will be blackened should arsenic be present, but not if antimony alone be present. Should there be some quantity of arsenic present, the whole solution also will become of a dark brown colour, leaving a stain on the tube, owing to the separation of arsenicum; but with antimony a few black flakes, settling into a heavy black precipitate, are observed, the solution remaining colourless.

With respect to the delicacy of this test, I find that 0·0075 of a grain of arsenious acid, dissolved in NaHO, and diluted with water to a bulk of 250 grains, produces, when treated as above described, a perfectly characteristic reaction on the paper, the solution, however, remaining colourless.

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PRELIMINARY NOTES ON THE

ISOLATION OF THE BITTER SUBSTANCE OF THE NUT OF THE KARAKA TREE (CORYNOCARPUS LÆVIGATA).*

By W. SKEY, Analyst to the Geological Survey of New Zealand.

A VERY interesting as well as a most important investigation in any country, whether for toxicological or for scientific purposes generally, is that which has for its object the identification and examination of the particular principle to which is due those poisonous or other marked effects which may have been observed on the administration of certain of its plants or herbs, or parts of them, to the animal system.

But especially is this the case in the country we are now settling, the case of its flora being in certain respects peculiar, and in many cases greatly divergent from that of any other country we are yet acquainted with; any addition, therefore, from such a quarter to the number of active principles recognised can hardly fail to be of value, as enabling us to attain to a more comprehensive view of the whole subject of vegetable medicinals or poisons—the manner of their association with other principles or with particular orders or parts of plants—and lastly, the mode in which they operate in producing their individual effects; while there is besides the chance that any principle so isolated and identified may be more useful medicinally, and more readily administered when separated from the plant.

Altogether the subject appears to be one eminently worthy of careful attention, and I have, therefore, from time to time examined many of those plants which have come the more prominently under notice by reason of their acknowledged potency in respect of the characters stated.

The last subject of these investigations has been the kernel of the fruit of the karaka tree, which, as is pretty well known, is extremely poisonous to man if taken in an unprepared state; and though I have not yet completed it, sufficient knowledge has, I think, been arrived at to render a statement of the results so far obtained interesting.

Not having personal acquaintance with the mode in which the karaka berry is prepared as food by the natives, nor of its action as a poison, I am indebted to Mr. W. Colenso, F.L.S., for the following accurate information:—

"1. Preparation as food.—The kernels were prepared for food thus:—In the autumn a large party would go to the karaka woods on the sea-coast, which were most rigidly preserved (tabooed), to gather the fruit; this was generally done by beating them down with a long pole (hence the term, "ka haere ki te ta karaka"—the verb *ta*, to hit, or strike, sharp, short, sudden blows with a stick; the same verb is used in speaking of the operation of tattooing), after which they gathered them up into baskets. In or near the adjoining beach large pits were dug for earth-ovens, into which, when ready, the karakas were poured, and the earth banked up in the usual way. These ovens were left several hours before they were opened, generally till the next day, or even longer, when the karakas were taken out, put in baskets, laced up, and placed under water, often at the mouth of some neighbouring stream or quasi lagoon, where also they remained some time (I believe a day or two at least), for the double purpose of destroying all remains of the poisonous quality, and for the loosening and getting rid of the skin and flesh (sarcocarp) of the fruit. When they were washed clean by knocking them about pretty roughly to rid them of the outer skin, &c., taken out, spread in the sun on mats and stages, and carefully dried; and when quite dry again put up in new baskets for winter use, for feasts, for distinguished visitors, and for gifts to friendly chiefs and tribes residing inland.

"As the same karaka woods did not bear alike plentifully every year, the years of barrenness were to the tribe seasons of calamity and want, the karaka being one of their staple vegetable articles of food.

"2. The symptons attending cases of poisoning through eating the raw kernel were—violent spasms and convulsions of the whole body, in which paroxysms the arms and legs were stretched violently and rigidly out, accompanied by great flushings of heat, protusion of the eyes and tongue, and gnashing of the jaws, but unattended by vomiting (very different in appearance and result from the bite of the poisonous spider, katipo, of which I have also seen and attended several cases, which are of a much more mild type, and never fatal). I mention this as both were likely to be caused in the same locality (near the uninhabited sea-shore) and season, and at first by a tyro might be mistaken. Unless speedily attended to, the poisoning by karaka quickly proved fatal; and even in those few cases in which I have known natives to recover, very likely it was more owing to the small quantity of the poison received into the system, than to the means used as *internal* remedies. As the sufferers were invariably little children, they were more easily dealt with; and to prevent the limbs becoming distorted, or stretched and rigid, a pit was quickly dug, into which the child was placed in a standing posture, with its arms and legs bound in their natural position, and the mouth gagged with a bit of wood to prevent the sufferer biting its own tongue; and there the child was left, buried up to its chin, until the crisis had passed by; sometimes it was also plunged repeatedly into the sea before being pitted. Fortunately the cases of karaka poisoning were but few, owing, no doubt, to the hard texture and disagreeable taste of the karaka kernel in its raw state; very much fewer than those arising from the eating of the sweet fruit of the tutu *(Coriaria)*, which latter, however, were more easily managed by the natives.

"The writer well recollects having seen at Wangarei (Bream Bay), in the years 1836-9, a fine healthy youth of about twelve years of age, who had been recovered from poisoning by karaka kernels. He, however, had not been properly attended to, as to the tying of his limbs in their right position while under the influence of the poison, and he was therefore now a curious spectacle, reminding one of the instrument called a caltrops more than anything else. One leg was curved up behind to his loins, and the other bent up in front with the foot outward; one arm inclined behind his shoulder, and the other slightly bent and extended forwards; and all, as to muscles, inflexibly rigid. He could do nothing, not even turn himself as he lay, nor drive off the sand-flies (which were there in legions) from feasting on his naked body, nor scratch himself when itching, nor put any food to his mouth. He was the only child of his parents, who, fortunately for him,

* Read before the Wellington Philosophical Society.

were both alive and took great care of him, turning and shifting his position very often by day and night, as, from his body not evenly resting, he could not possibly remain long in one position. When not asleep he was laughing (if not eating), and greatly enjoyed his being so placed that he could see the children at play, in which he always encouraged them by his voice, often seeming the merriest of the village. I frequently sat by his side during my visits, to talk with him, and to drive away the tormenting sandflies, which he would beg me to do. His skin was remarkably fine and ruddy—I might call it pretty—being wholly without eruption, blemish, or scar; his teeth pearly white, and voice and laugh regularly strong, hearty, and ringing. His eyes were very brilliant and of an intelligent cast; but in conversing with him I always thought his intellect was not so sharp (or developed) as ordinarily that of Maori boys of his age."

This interesting account discloses the fearful nature of the poison of the karaka nut, and also that the Maoris employ two distinct processes—baking and washing—in their mode of preparation of this article for food; but it cannot be gathered therefrom whether both processes are necessary for the removal of the poison from the kernel, and if not which is the essential one.

It will be noticed that the kernel only is spoken of as being poisonous, the fruit which surrounds it in its natural and ripened state being, as is well known, wholesome and pleasant, though not powerfully flavoured.

In pursuance of my object, therefore, I gathered a quantity of the kernels from which the fruit had completely rotted off, and after removing the woody husk I bruised them very finely, and put part to bake at a temperature of 212° for four hours, when it appeared their bitter flavour was destroyed.

The other part I steeped in successive quantities of cold water for two days. The steep-water separated from the bruised nut contained a great variety of substances, those positively identified therein being approximately in the order of their relative abundance, as follows:—Vegetable albumen (emulsion), casein (legumin), grape sugar, gum, a bitter substance, and a tasteless essential oil, which latter floated in greater part on its surface. The solid insoluble part of the nut left after the successive additions and abstractions of water was nearly tasteless, and completely devoid of all *bitterness*, and showed a resemblance in chemical composition to the insoluble part of hazel nuts.

The competence of either of the processes used by the Maoris (baking or washing) in the preparation of the nut, for the decomposition or removal of the bitter part of it, being thus shown, it naturally occurred to me that this bitter might be the poisonous part of the nut. I therefore made the isolation of this principle for the present my first object.

The bitter part in question was soon found to be capable of absorption by animal charcoal, and of removal therefrom by hot alcohol. I therefore took advantage of this department to obtain it in a pure state for examination. The details of this process are as follows:—

The kernels are well crushed and triturated with successive quantities of water (cold) till their bitter taste is gone. The solutions thus obtained are rendered distinctly acid to the taste by acetic acid; by which the casein and emulsion present are precipitated, and the filtrate therefrom agitated with animal charcoal till the bitter substance is removed. The charcoal is then collected and mixed with boiling alcohol, and the pure alcoholic solution of the bitter substance thus obtained is allowed to remain for two or three days at common temperatures, when the bitter part crystallises out in beautifully radiating acicular forms.

The characters of these crystals are as follows:—Intensely bitter; colour, white; lustre, pearly; feebly acid; at 212° F. melts; gives a dark rose colouration with warm sulphuric acid; soluble in hot water, and feebly so in cold water; soluble in alcohol, also in hydrochloric and acetic acids; soluble in ammonia and potash; insoluble in ether and chloroform; does not give any precipitate with tannic acid, nor with potasso-iodide of mercury, nor potasso-sulphocyanide of zinc; does not contain nitrogen.

The evidence as submitted above shows that the principle is not of an alkaloidal nature.

Its deportment with sulphate of copper and potash is strikingly similar to that of digitaline to the same tests. Both give green precipitates of a tint very similar to arsenite of copper. This property of either of these vegetable principles to give green precipitates with copper under these circumstances seems characteristic of them, as, among the numerous substances the most likely of any I know to give this reaction, not one has, on experiment, been ascertained to deport itself in this manner. Thus either of these principles is readily distinguishable in this way from picrotoxia, resins generally (including common resin), soaps, gums, and the bitter principle of *Phormium tenax*.

The green precipitates formed in this way by the bitter of the karaka and digitaline respectively are, however, readily distinguished from each other by subjecting them to a rise of temperature (120° F. to 212° F.); that containing the digitaline is unaffected, while the other precipitate speedily changes its colour to yellow, the copper being reduced to the suboxide, as if grape sugar were present. Further, if the proportion of the karaka bitter to the copper and potash is not properly adjusted, reduction commences at once.

It appears, however, that if the solution of digitaline is boiled with acid prior to the mixing with copper and potash, a great reduction of the copper will take place on raising their temperature to 200° F.

Taking all these facts into consideration, I am inclined to believe that the bitter of the karaka nut is a glucoside, and that digitaline falls into the same class, though I have not known this character imputed to it before.

An appropriate name for this bitter principle of the karaka will be, I think, *karakine*, and this name, therefore, I propose to give it.

Having failed, after a careful examination of the nut for vegetable alkaloids, to find any principle having the characters of these bodies, I conclude that the bitter substance here treated of (karakine) is the poisonous part of it; but not having sufficient of this principle separated to allow of a proper trial of its effects upon the animal system, I am unable to confirm or disprove the correctness of these surmises, but I hope at an early date to be able to supplement this paper by a statement of results of experiments undertaken to settle the question.

As being connected with this subject I may state, in conclusion, that the inner bark of the tree is also bitter, probably from the presence of karakine. The outer bark is not bitter, but astringent from the presence of tannin, while the sap, the wood, and the leaf (which is, I hear, wholesome to cattle) taste sweet (sugar), with not the least bitterness. These observations were taken in July.

OBSERVATIONS ON THE

DURATION AND MULTIPLE CHARACTER OF FLASHES OF LIGHTNING.

By OGDEN N. ROOD,
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Arago has classified the different forms of lightning under three heads:—1st, linear zigzag flashes; 2nd, flashes appearing as a broadly diffused light (sheet lightning, heat lightning); and lastly, the rarely occurring discharges which are seen as slowly moving balls of fire.* That the first form is due to the production in the atmo-

* See Dr. Ernst E. Schmids' "Lehrbuch der Meteorologie;" Leipzic, 1860, p. 791.

sphere of a gigantic electric spark has since Franklin's time been disputed by no one, and, as far as I can ascertain, the majority of physicists and meteorologists *suppose* that flashes of the second form are due to the same cause, their light being seen either by transmission through or reflection from the clouds.

Before detailing my own observations on this matter, I wish briefly to mention the results thus far obtained by others. Among the most important of them is an experiment by Dove, who, in 1835, during a thunder-storm, was able, by the help of a revolving disc with coloured sectors, to satisfy himself that single flashes of lightning often consisted of a number of apparently instantaneous discharges.* Arago suggested for the determination of the duration of the flash the use of a rotating circular disc, painted with a hundred black and white sectors. He supposed that, from the appearance presented by the disc when illuminated by the flash, the observer would be able to ascertain its duration.† Wheatstone, with a revolving disc of this kind, found the duration of the flash too short for measurement, and set it as less than $\frac{1}{1000}$ of a second. Casselmann, in 1847, noticed that single flashes of lightning sometimes moved the index of the telegraphic apparatus forward over two, four, or even six letters, and argued thence the multiple character of the discharge, which indeed had previously been observed by Dove.‡ Faraday, in 1857, noticed that the duration of some flashes of lightning *seemed* to him fully as great as a second, if not more, and attempted to explain this by a phosphorescence of the portion of the cloud traversed by the flash.|| C. Decharme, at Angers, in 1868, while a distant storm was raging, saw the heavens from time to time illuminated by a light which *seemed* to last from a half to an entire second.§ In these last two observations no apparatus was used for actual measurement. To the above, I may add a rough measurement of the duration of the lightning flash, made by myself in 1870, with an apparatus differing from that employed by other observers, the interval of time obtained being often $\frac{1}{30}$ of a second, though sometimes it was considerably smaller.¶ Finally, after finishing the observations and measurements detailed in the present paper, I saw in *Nature*, July 25th, 1872, an account of some experiments which were made by B. W. Smith, with the aid of a "colour-top," or after the method of Dove. Mr. Smith notices the fact that the duration of the flashes sometimes seem to be prolonged by an action, which he, like Faraday, attributes to a phosphorescence of the cloud in which the discharge takes place. These observations appear at first sight to be more or less contradictory, but with the aid of the more complete set of results recently obtained by myself it will be easy to bring them into harmony.

New Observations.

(1). Immediately after my own experiment I arranged a small train of toothed wheels driven by a spring, so that it should be capable of rotating a circular pasteboard disc which was provided with four *open* sectors of 3° each. This apparatus was constantly near me ready for use, but an entire year elapsed before an opportunity occurred. I noticed then, upon one occasion, about midnight, that my room was from time to time illuminated by lightning-flashes, whose duration seemed as great as an entire second; and upon making an examination with the rotation apparatus, it was found that each flash consisted of a considerable number of isolated and apparently instantaneous electric discharges, the interval between the components being so small that to the naked eye they constituted a continuous act. The lightning was of the second form, and, judging from the accompanying thunder, was not very distant; but it soon ceased, so that I was not able to gain any further information.

(2). The next observations were made late one evening in last June. The storm was at a greater distance, and, as before, the clouds were illuminated by unseen flashes. Each flash again consisted of a considerable number of apparently instantaneous discharges, perhaps about ten; but the total duration of the compound flash was so great that, with the lowest practicable rates of rotation, I was entirely unable to form even a rough estimate of the interval of time involved. The storm allowed me no time for the study of the components of the flashes.

(3). During the following month, at about the same hour in the night, I again observed, near the horizon, clouds illuminated by a more distant storm. The multiple flashes were once more noticed, and when the disc revolved at rates of five to ten revolutions per second, the light from the four sectors was quite often drawn out into a circular streak, which extended around its entire circumference, showing a steady and continuous duration of some of the components for at least $\frac{1}{20}$ to $\frac{1}{40}$ of a second. These streaks were observed quite often and with perfect distinctness, though the figures just given are to be considered only rude approximations. Mingled with these, if not actually constituting a portion of them, were apparently instantaneously flashes. The total duration of the act was so great as again to defeat attempts at measurement.

(4). A thunder-storm occurring at 2.30 a.m., on July 30th, gave a better opportunity. The observations, like the preceding, were made at Peacedale, R.I., and the majority of the electrical flashes were so distant that the accompanying thunder was heard only occasionally, and, as before, the flashes were not seen directly, but by transmission. In spite of this, however, many of them were very vivid, and much rain fell during the time occupied by the observations. Previously I had arranged the apparatus for the measurement of greater intervals of time, by attaching to one of the axes a disc with a single open sector, which could be rotated at quite low rates, the terminal axis being provided with a fan. When this disc was revolving at the rate of 2·04 turns per second, the open sector was several times observed to make at least two complete revolutions during a single flash, which gave a total duration for the act in those cases of about one second; and I may add that after the completion of the experiments described below, durations of the total act were observed, even with the naked eye, which must have been as great as a second, and the light illuminating the room was noticed during the continuance to flicker twice or thrice. The total duration was, however, quite variable, and often amounted only to a small fraction of a second.

With a disc having only a single narrow, open sector, and making from 12 to 15 revolutions per second, the multiple character of the flashes was then studied. The flash consisted of a considerable number of isolated electrical charges, which sometimes were executed with so much regularity as apparently to cause the disc to rotate backward, with a slow motion, through 30° or 40°, the cause being analogous to that involved in the phenomena of the stroboscopic discs. Several times, also, instead of seeing the sector single, I noticed that it had a form approximating to that of the letter X or V, which evidently was due to the circumstance that almost involuntarily my eyes had glanced from one side of the disc to the other, thus giving rise to a combination of distinct visual impressions.

Next, for the purpose of examining the individual constituents of the flash, I placed on the terminal axis a circular disc, each quadrant containing a square opening of about 5°; and when this was revolving eleven times in a second, sometimes the flash was seen to consist of a small number (three to six) of apparently instantaneous discharges, the form of the square not being at all distorted. The same was afterward noticed with a velocity as high as 22 revolutions per second, and if the areas of

* *Pog. Ann.*, 1835, p. 371.
† Becquerel, "Traité de l'Electricité et du Magnetisme," vol. vi., pp. 128, 129. Paris, 1840.
‡ *Fortschritte der Physik* for 1847, p. 668.
|| *Phil. Mag.*, IV., vol. xiii., p. 506.
§ *Fortschritte der Physik*, vol. xxiv., p. 644.
¶ *Amer. Journ. of Science and Arts*, III., vol. i., Jan., 1871.

the squares had been doubled this could not have escaped my attention, but as in many cases nothing of the kind was seen, it follows that the duration of the apparently instantaneous constituents was less than about $\frac{1}{1000}$ of a second.

On the other hand, sometimes the continuous duration of the constituents was such that the whole circumference of the disc was surrounded by a bright or faint ring of light, according to the original luminosity of the flash, which gave a duration for the continuous act at least as great as $\frac{1}{31}$ of a second. Quite often I was able to notice that these continuous discharges did not make up all the elements of the flash, but that they were terminated by an isolated and instantaneous discharge.

(5). The last set of observations were made at Stockbridge, Mass., on the evening of August 25, 1872. The thunder was heard quite loudly, and direct zigzag flashes were occasionally seen; rain also fell. The disc employed on this occasion had only *one* square opening, the sides of which were 7 m.m. (corresponding to about 12°), these dimensions having finally been found preferable. The rate of rotation was kept nearly constant by winding up.

The flashes were usually multiple, and the duration of the components was often or generally quite long, being as great as $\frac{1}{30}$ of a second, if not longer; the brilliancy of the ring of light was considerable, and showed no signs of falling off throughout its whole extent. It was again noticed that when the duration of the earlier components had thus been considerable, the last act (or certain acts) were instantaneous. Eight or ten times it was fairly noticed that the components of certain flashes were to all appearance instantaneous, there being no distortion in the shape of the square. If its area had been increased by one-half this could not have escaped my attention, and would have implied a duration of $\frac{1}{300}$ of a second. A number of uncertain observations were made, leading to a duration of the components, in some cases, of from $\frac{1}{300}$ to $\frac{1}{600}$ of a second, and, finally, in two cases the breadth of the square was distinctly doubled, giving a duration of about $\frac{1}{600}$ of a second.

To the above I must add several observations made by the naked eye on *normal zigzag* flashes, when on five or six occasions the duration of the direct flash was estimated at not less than one second, the light seeming to pour steadily in a stream from the cloud to the earth. They correspond to that of Faraday, referred to in the earlier part of this article.

It is evident from the foregoing that the nature of the lightning discharge is more complicated than has generally been supposed; it is usually, if not always, multiple in character, and the duration of the isolated constituents varies very much, ranging from intervals of time shorter than $\frac{1}{1000}$ of a second up to others at least as great as $\frac{1}{30}$ of a second, and furthermore, what is singular, a variety of this kind may sometimes be found in the components of a *single* flash. The long durations of certain constituents of the flash induced me afterward to make some experiments with a view of ascertaining the cause of this singular and unexpected phenomenon; and although the results are negative in character, still it may not be amiss briefly to mention them. I constructed a glass tube similar to those used for studying the spectral lines of rarefied gases, and having connected it with a mercurial air-pump, rarefied the ordinary air contained in it. A Leyden jar, with a coating of 738 square centimetres, was connected with the tube, and a spark micrometer was introduced into the circuit, so as to interrupt it, and thus to cause the jar fairly to charge and discharge itself, as otherwise the prolonged discharges of the induction-coil made their appearance. The tube was placed in front of the rotation apparatus used by me in investigating the electric spark, and its appearance studied at tensions from 1 m.m. upward, till the resistance became so great as to cut off the discharge. In every case the light appeared to be instantaneous, that is, its duration was so small as to preclude the idea of its affording an explanation of the long intervals occurring in the case of lightning flashes. Of course, in all these experiments, the actual rate of the mirror was quite low. I then repeated the same experiment with the vapour of water, at a tension of about 15 m.m., with the same result.

Afterward a jet of steam was directed across the path of the electric spark in the free air, with a similar negative result. Finally, thinking that possibly the rain might in some way be concerned in the production of the prolonged durations, while sparks 10 to 15 m.m. in length, obtained from a smaller jar, were traversing the ordinary atmosphere, fine watery spray was directed across their path by the use of an "atomiser," without sensibly increasing their duration. These experiments may be explained by the greater volume of the atmospheric electricity, but suggest, on the other hand, the possibility of a real prolongation of some of the constituents of the flash.

Recently the spectrum furnished by flashes of lightning has been examined by Dr. H. Vogel.* A number of lines were identified, as also occurring in the spectrum of the electric spark in the ordinary atmosphere; but what is remarkable, it was found that sometimes the spectra consisted of bright lines on a dark ground, while at others the bright lines were traced on a less bright continuous spectrum, and, finally, sometimes a continuous spectrum destitute of lines was obtained. The discharges were principally of the form known as sheet lightning. I consider it probable that the continuous spectra destitute of lines, observed by him, were due to the *prolonged* constituents mentioned in this paper, and the occurrence of bright lines on a less bright ground I would refer to cases when instantaneous and prolonged constituents were mingled as noticed by myself; the normal spectrum of bright lines on a dark ground, finally, being produced by flashes more nearly instantaneous. Since writing the above I find that Wüllner, in No. 11 of *Pog. Ann.* for 1872, has shown that, in rarefied air, instantaneous sparks give a spectrum consisting of *lines*, while the prolonged constituent of the spark of an induction-coil often produces a *banded* spectrum, which under certain circumstances approximates to one that is continuous.

It will be noticed, that while making observations No. 5 I was in the area occupied by the storm, in No. 4 on its outer edge, in No. 1 out beyond the edge, and in No. 3 the storm was quite distant. Yet in all these cases the character of the lightning, as far as could be observed, was quite identical, furnishing, as it seems to me, argument in support of the hypothesis that zigzag lightning, heat and sheet lightning, &c., are really identical, being in point of fact due to the same cause, but viewed under different conditions.

Best Form of Apparatus for the Study of Lightning Flashes.

From the contents of this article it will be seen that additional observations are still desirable, and hence I wish to describe more definitely the apparatus which after many trials answered best, as well as to suggest one of a more perfect form. At the outset I found it necessary to discard the plan of viewing a figure painted on an opaque disc, which seems to be the only one which had occurred to other physicists, its indications being uncertain, and the loss of light so great that it was impossible to observe even the *presence* of the less prominent constituents of the flash. It is advisable, then, to use a black or *grey* opaque disc, about 100 m.m. in diameter, with an *open* sector, and, as has been shown in the present article, this is the only mode by which, thus far, actual measurements of the duration have been obtained. The multiple character of the flash renders it unadvisable to use more than one sector. The best form for the shortest and longest durations is that of a square, with sides of from 7 to 10 m.m.; for medium durations the same form can be retained with larger dimensions, and for examining the multiple character of the flashes simply a long narrow sector of 1° or 2°

* *Pog. Ann.*, 1871, No. 8, p. 653.

is preferable. The use of the disc micrometer, described by me in another place, I do not consider practicable with storms in our latitudes, though the frequency of the flashes in the Tropics might render possible its employment. A spring rotation apparatus, on account of portability, may be used, being so contrived as to admit of rates from one revolution up to twenty or thirty per second. This should be provided with some contrivance by which the observer might always be able to ascertain to what extent the clock-work at the moment had run down, so that the rate of the disc's rotation could afterward be found, without at the time interrupting the observations. A simple plan is to wind on the cylindrical portion of the key a string, which passes downward through the base of the instrument, knots being tied on it so as to indicate the number of turns already made by the slowest wheel.

The following is a more elaborate form, with which more accurate results could be attained, and which probably would reveal details quite beyond the reach of the simpler apparatus. A circular disc of the kind just mentioned is to be set in rotation by clock-work run by a weight; an image of the disc, of the natural size, is to be formed on a vertical plate of ground glass by an achromatic lens of 7 or 8 inches focus and of large aperture ("portrait combination" from a photographic camera). An opaque circular screen is to be placed around the edge of the disc so as to cut off all stray light, which I found in my experiments very annoying. The observer placed behind the ground glass will measure simply with a pair of compasses the length, &c., of the streaks, in the manner described by me in another place,* and the difficulty of accommodating the eyes for the image will in great part vanish, from the circumstance that the hands will be resting on the ground glass where the images are expected. It is scarcely necessary to add that to use this or any method successfully will require some previous training, which I think could best be obtained by a repetition of the experiments and measurements described by me in a former number of this journal.*—*Amer. Journ. of Science and Arts.*

NOTICES OF BOOKS.

Annual Report of the Board of Health to the General Assembly of Louisiana. New Orleans. 1873.

Although the Chemical News is not a medical paper, we feel deeply interested in the progress of sanitary science. The relative value of disinfectants, the purification of air and water, the treatment of town sewage, and the consumption of smoke, are questions into which we always feel it our duty to enter, and which few, if any, of our readers will deem irrelevant.

On these subjects the volume before us supplies some interesting information. New Orleans is a city of evil report in a sanitary point of view, whence the results obtained there are all the more valuable. The favourite "disinfectant and deodorant" appears to be a mixture of the chlorides of zinc and iron. It is a by-product of a method for recovering tin from tinners' waste. The scraps are dissolved in hydrochloric acid, and the tin precipitated by the immersion of metallic zinc. The residual solution contains, we are told, about 6⅛ grs. of chloride of zinc, and 5 grs. of ferrous chloride, per pint, and is sold wholesale in New Orleans at 50 cents per gallon. The iron is converted into perchloride by treatment with nitrate of soda and hot hydrochloric acid, which enhances its disinfecting powers. From a pint to a quart will, as we are told, "perfectly deodorise ordinary vaults (cesspools ?), and will not require repetition in less than ten to fifteen days." It is said that these metallic salts destroy totally and immediately all sulphuretted hydrogen, sulphide of ammonium, and phosphuretted hydrogen, the chief offensive and deleterious emanations from vaults, &c.

That sulphuretted and phosphuretted hydrogen are offensive and deleterious we fully admit; but that they are the chief source of danger in sewage gases is, in our opinion, by no means demonstrated. Phosphide of hydrogen is by no means an ordinary result of the spontaneous decomposition of animal and vegetable refuse, and certain phenomena once ascribed to its evolution, such as the luminosity of the glowworm and of touch-wood, have been found to be of quite another nature.

Lime, as a disinfectant, is not recommended, as matters in a state of decomposition are ordinarily alkaline, a point which we commend to the authors of certain sewage schemes at home.

In the especial report of Dr. Perry, the chemist to the Board, we find notice of certain other disinfectants, such as Terry's zinc-iron mixture, containing 14 per cent of copperas, 20 per cent of crude carbolic acid, a slight sediment of peroxide of iron, with a trace of sulphate of zinc. Bromo-chloralum is chiefly chloride of aluminium, with small quantities of the chlorides of calcium, magnesium, sodium, and iron, and about 30 grains of bromine per pint in combination with sodium. It prevents decomposition in animal fluids, but is useless for destroying the sulphur compounds.

Egyptian disinfecting powder (Terry's) consists of clay dried and powdered, and mixed with 2·5 per cent of carbolic acid and 0·7 of sesquioxide of iron. It is of little value.

In case of yellow fever, carbolic acid is exclusively recommended. All bedding and clothing are to be steeped in a dilute solution of the pure acid, which is also to be thrown in a fine spray upon the walls, ceilings, floors, and furniture. Experiments have been undertaken to determine whether the odour of carbolic acid, used as a disinfectant on board ships, would injure a cargo of sugar. After long exposure to the vapour, no difference could be recognised either in the smell, taste, or colour of the sugar.

New Orleans cannot be congratulated on its sanitary arrangements. The city is not sewered. "From three-fourths of the houses the solid offal is removed pretty regularly by carts; that from the other fourth is thrown into the streets and gutters. All the liquid and semi-liquid refuse, slops, &c., are allowed to run into the gutters, in seven-eighths of which they remain." A sample of the mud from the gutters, weighing 1000 grs., and containing 24 per cent of solid matter, on evaporation yielded 0·015 per cent of free ammonia, and on ignition with soda lime gave a further amount of nitrogen = 0·88 ammonia. The subsoil must be frightfully polluted. The water from a shallow well not now used for drinking purposes gave, per litre, 604 milligrms. of ammonia and 456 of nitric acid. The air contained in one instance as much as 360 grms. of albumenoid ammonia per million cubic metres. The most unsavoury locality in London, according to the analysis of Dr. R. A. Smith, quoted for comparison, showed only 271 grms. Having regard to these circumstances, and to the heat of the climate (the mean temperature being 83·85° F. for July, 84·45° for August, and 81·5° for September, eminently calculated to promote brisk decomposition among the accumulations of organic refuse), we can only express surprise that the annual mortality does not exceed the recorded proportion of 31·98 per 1000 of the entire population.

It is satisfactory to learn that the determinations of free and albumenoid ammonia, both in water and air, are performed by the process of Wanklyn and Chapman, which may now fairly be said to have established itself over the whole civilised world.

Concerning the diffusion of fœcal matters in the soil, we find statements apparently, at least, contradictory. Thus we are informed that "waters of wells in the near vicinity of privy-vaults are not perceptibly affected by them." This view seems somewhat strange in connection

* *Amer. Journ. of Science and Arts*, III., vol. iv., Oct., 1872.

with the highly polluted state of the wells to which we have referred above. As far as we can judge from the facts adduced, sewage irrigation would be a more serious mistake in the climate of New Orleans than it is in England. The only choice before the citizens, if they wish to improve their sanitary condition, is, either the dry-closet system, or, if sewers are preferred, the most efficient mode of precipitation. We shall await with interest the improvements which they will doubtless ere long introduce, and shall look forward to the results of their experience.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Bulletin de la Société Chimique de Paris, No. 7, 1873.

Note on an Aspirator.—M. H. Lasne.—If we allow water to flow in a tube whose diameter increases continuously, the same mass of water will traverse in a given time each of the two extreme sections; but from the first to the second it loses a part of its speed. This loss is due to a force which resists the movement of the liquid, and if we neglect friction there remains the difference of the pressures exerted upon the two sections considered. The pressure, therefore, must vary from one section to another, being weakest where the speed is greatest, *i.e.*, in the narrowest section. If the larger opening of the divergent tube opens to the air, the water in it is subject to atmospheric pressure, and if we cause the narrowest part to communicate with a barometer-tube the mercury rises to a certain height. By adapting suitably the ratio of the two sections, the mercury may be made to rise to a height which only differs from that of the barometer by the tension of watery vapour at the temperature of the experiment. On placing the apparatus in connection with a receiver under pressure higher than it can support, air is drawn out; the pressure in the receiver falls until equilibrium is established. The arrangement of the apparatus cannot be understood without diagrams. The author considers that, without professing to replace the air-pump, it will be very convenient for a number of operations which it may be desirable to perform under reduced pressure, especially for distillations and evaporations at low temperatures, for which the air-pump is not well adapted.

On the Sulphovinates.—M. Berthelot.—(1). Reaction of sulphuric acid upon alcohol.—This gives rise to widely different products according to the temperature. If the two bodies are previously cooled and gradually mixed, avoiding any rise of heat, no reaction takes place at first. On prolonged contact there is formed a peculiar sulphovinic acid, whose salts differ from the ordinary sulphovinates, into which they may be transformed by boiling. Concentrated acid and absolute alcohol mixed in equal volumes, and without special precautions, give rise to a strong disengagement of heat, and yield ordinary ethyl-sulphuric acid. The yield varies according to the manner in which the mixture takes place, *i.e.*, according to the local rise of temperature, and the relative proportions which come in contact where the acid and the alcohol are poured together. For instance, on mixing without precaution 1 part by weight of stray acid and 5 of alcohol, the author found at the end of one hour 10 per cent of the acid had become sulphovinic acid, and after twenty-four hours 26 per cent. On carefully mixing 1 part by weight of strong acid and 2 of alcohol, the amount etherified was, after one hour, nearly nothing, and scarcely increased by a few hundredths in twenty-four hours, although the excess of acid in comparison with the former experiment should have promoted combination. In all cases the action gradually reaches a fixed limit which it cannot pass. Thus, strong acid and absolute alcohol at common temperatures, $(SO_4H+\frac{1}{2}HO)+C_4H_8O_2$, yielded, for every 100 parts of sulphuric acid, the following quantities of sulphovinic acid:—

After 40 hours	.. ..	56 per cent.
,, 90 ,,	.. ..	59 ,,
,, 147 days	.. ..	58·8 ,,

which limit was not exceeded. The reaction is accelerated by heat. If the temperature is raised to 100° in four hours, we obtain 56 per cent of ethyl-sulphuric acid. The application of heat must not be prolonged too much, as after exposing the mixture to 100° for 10 hours we find only 42 per cent of ethyl-sulphuric acid. This retrograde action is due to the slow formation of ether at the expense of the ethyl-sulphuric acid, which tends to reproduce sulphuric acid. The production of ether becomes very abundant if the temperature is raised to 145°. Between 160° and 170° ethylene is formed; it is, therefore, needful to raise the temperature to 100°, and maintain it for a very short time in order to secure the immediate formation of ethyl-sulphuric acid in its most stable form, but a prolongation of that heat, as well as a higher rise, must be avoided.

Reaction of Water on Sulphovinic Acid and on its Salts.—This action is first indicated by the fact that the formation of sulphovinic acid does not pass the limit of 59 per cent when equal equivalents of sulphuric acid and alcohol are in contact. This limit is due to the presence of water—the product of etherification—which decomposes pure sulphovinic acid in an inverse manner, the decomposition stopping at the same limit as the reciprocal combination. Between these four bodies—alcohol, sulphuric acid, sulphovinic acid, and water—there is formed a certain equilibrium (as in the formation of other compound ethers), though the limit is not always identical, since the bibasic organic acids, *e.g.*, oxalic, succinic, and tartaric, form at once the compounds, a neutral and an acid ether. Nevertheless, the general phenomena remain similar. The proportions of the equilibrium are not affected by temperature unless new compounds are produced, such as ordinary ether and olefiant gas. In fact the limit of the reaction being 59 per cent of ethyl-sulphuric acid in the cold, and at the end of several weeks; the author finds, on the other hand, 56 per cent at 100°, after the lapse of a few hours. The limit of the equilibrium is equally modified by the proportions of the four components. In course of time, water especially decomposes sulphovinic acid, and the presence of an excess of water at the outset lowers the limit of etherification, and delays the combination as shown by the following figures:—

Nature of the Mixture.

(1). $SO_4H+C_5H_8O_2+\frac{1}{2}HO$
(2). $SO_4H+C_4H_6O_2+1\frac{1}{2}HO$

	40 hours.	90 hours.	20 days.	147 days.
(1).	56·0	57·4	59·0	58·8
(2).	13·2	21·2	41·2	54·8

Alcohol containing 25 per cent of water yielded only 8 per cent of sulphovinic acid in a month. Similarly if water be added to sulphovinic acid or to one of its salts, there will ensue decomposition and reproduction of alcohol and acid, slowly in the cold, but rapidly at 100°. The decomposition of the sulphovinates is less rapid than that of free sulphovinic acid. Hence, they can be evaporated to crystallisation without destruction, but cannot be kept for any length of time in solution. The decomposition of dissolved sulphovinates when once set up goes on accelerating, since the sulphuric acid liberated seizes its equivalent of the base, and sets free a portion of the sulphovinic acid. During the destruction of these salts by evaporation each equivalent of sulphovinic acid sets free two equivalents of sulphuric acid. Two more equivalents of sulphovinic acid result from the action of this sulphuric acid upon the dissolved sulphovinates. These, in turn, become 4 equivalents of sulphuric acid, and thus the reaction once set up, goes on in a geometrical progressing. Hence it is useful to keep the solutions of sulphovinates during concentration or preservation in a neutral or slightly alkaline condition by the addition of a trace of carbonate or bicarbonate of soda. All the known sulphovinates when in a solid form contain water of crystallisation, and all in a longer or shorter period undergo decomposition. This alteration results from the action of the crystalline water which is eliminated by efflorescence.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 4, 1873.

The following original papers and memoirs are contained in this number:—

Relation Existing between the Aromatic Senfols (Essential Oil of Mustard) and Cyanides.—W. Weith.—This monograph treats on the following subjects:—Conversion of cyanphenyl into phenyl-senfol respectively. The author's view is, that when the structure and constitution of the aromatic cyanides and senfols are mutually compared, it might be possible to convert the former into the latter, according to the formula—

$$\underbrace{R.NC}_{\text{Cyanide.}} + S = \underbrace{R.NCS.}_{\text{Phenyl-senfol.}}$$

The experimental realisation of this view is confirmed, since the author, while commencing with the phenyl series, has succeeded in converting cyan-phenyl, by the aid of aniline, into sulpho-carbanilide, according to the following formulæ:—

$$\underbrace{C_6H_5.NC}_{\text{Cyan-phenyl.}} + S = \underbrace{C_6H_5.N.CS.}_{\text{Phenyl-senfol.}}$$

$$\underbrace{C_6H_5.NCS}_{\text{Phenyl-senfol.}} + \underbrace{C_6H_5.NH_2}_{\text{Aniline.}} = CS\begin{cases} N\begin{cases} H \\ C_6H_5 \end{cases} \\ N\begin{cases} C_6H_5 \\ H \end{cases} \end{cases}$$

The subjects further further treated of are:—Preparation of sulphocarbotoluide from cyan-tolyl. By the substitution of toluidine for aniline in the reaction just alluded to, sulpho-carbotoluide is obtained with all its characteristic properties; benzo-nitrile and sulphur gave

no positive result. Desulphuration (*entschwefelung*) of phenyl-senfol is obtained at from 180° to 200° by the aid of finely-divided metallic copper, the result being the formation of benzo-nitrile, which appears to be a secondary product, since it would appear that cyan-phenyl is first formed, a fact confirmed by the conversion of the latter into benzo-nitrile by heating the cyan-phenyl in a sealed tube at 220°.

Phenyl-Propyl-Alcohol.—R. Fittig.

Arseniuretted Hydrogen.—J. V. Janowsky.—After briefly enumerating the well-known properties of this poisonous gas, and alluding to its instability, the author records his experiments with the gas on terchloride of phosphorus, which results in the formation of phosphor-arsenic, (PAs), a solid body decomposed by water, insoluble in alcohol, ether, and chloroform, and slightly soluble in sulphide of carbon. Sulphuric and hydrochloric acids do not act upon this body at the ordinary temperature; concentrated nitric acid oxidises it, giving rise to the formation of arsenic and phosphoric acid. Solutions of caustic alkalies and of caustic baryta decompose the phospho-arsenic, even at the ordinary temperature, with formation of phosphuretted and arseniuretted hydrogen, phosphorous and arsenious acids, and metallic arsenic. When ignited in the air, the phosphor-arsenic yields arsenious and phosphoric acids. The product of the decomposition of the compound just alluded to and of water has the following composition ($As_2P_2O_3$) in 100 parts:—As, 70·53; P, 19·44; O, 10·03. The concluding portion of this paper treats on the dissociation of arseniuretted hydrogen when in contact with terchloride of arsenic, whereby metallic arsenic and hydrochloric acid are formed—$AsCl_3 + AsH_3 = 2As + 3HCl$.

Combinations of the Aldehydes and Alcohols with the Aromatic Hydrocarbons.—A. Baeyer.—The fourth portion of a monograph on this subject, this instalment being divided into the following sections:—Formaldehyde and aromatic hydrocarbons, viz., benzol, diphenylmethan; substitution products of aldehyde and the aromatic hydrocarbons; chloral and benzol; dichlor-aldehyde and benzol; toluol and chloral; monochlor-benzol and chloral; monobrom-benzol and chloral; benzol and bromal; alcohols and aromatic hydrocarbons.

On some Naphthaline Compounds.—J. Grabowski.

Action of Sulphuric Acid upon Chloral.—J. Grabowski.—After briefly referring to the researches of other scientific chemists on this subject, the author observes that chloral readily forms a compound with sulphuric acid, the formula being $C_8H_6Cl_{12}S_2O_{11}$. This body is not decomposed by cold water, but by warm water it is converted into chloral, or products of its decomposition, and in sulphuric acid. The sulpho-chloral is readily soluble in alcohol, but then, also, decomposition sets in. In ether the sulpho-chloral is soluble without undergoing any decomposition.

Contribution to our Knowledge of Monochlor-Sulphuric Acid.—M. Müller.—This essay, elucidated by a large number of complex formulæ, records the results of the author's researches as compared with those of Williamson and others on this subject.

Lecture Experiments to Illustrate Combustion.—K. Heumann.

Researches on some Oxidising and Reducing Agents.—J. Thomsen.—This monograph, abridged from the author's more extensive pamphlet on this subject, treats on the following substances, viz.,—Reducing agents, sulphurous acid, protosulphate of iron, protochloride of iron, and protochloride of zinc; oxidising agents—chlorine and bromine, hypochlorous acid, permanganate of potassa, peroxide of manganese, chromic acid, and peroxide of hydrogen.

On Mutual Constancy of Affinity (Gemeinschaftliche Affinitäts Constante).—J. Thomsen.

On Aconic Acid.—F. Meilly.—The acid alluded to was first discovered by Kekulé, and prepared from bibrom-pyrotartaric according to the following formula:—$C_5H_6Br_2O_4 - 2HBr = C_5H_4O_4$. The author describes at some length the soda, baryta, zinc, copper, and silver salts of this acid. Most of these salts are crystalline, and soluble in water. The greater portion of this essay—elucidated by lengthy and complex formulæ—is devoted to the description of the researches on the aconic acid methyl-ether, or methyl-aconic acid, and on the action of acetic anhydride and aconic acid.

Action of Oxalic Acid Ethyl Ether upon Naphthylamine.—M. Ballo.—This paper treats chiefly on naphthyl-oxaminic acid and its salts.

Composition of Suint.—E. Schultze.—The continuation of an essay on this subject. This part treats chiefly on isocholesterine, $C_{26}H_{44}O$, and derivatives thereof.

On Aceto-Cinnamon, and some other Combinations Formed by the Dry Distillation of a Mixture of Cinnamate of Lime and the Acetate of that Base.—C. Engler and A. Leist.

A More Extended and New Method for the Preparation of Ketons.—C. Engler and A. Leist.

Contribution to the History of the Violet-Coloured Rosaniline Derivatives.—Dr. A. W. Hofmann.—In this paper the eminent *savant* treats on a newly-discovered substance resulting from the reaction of a mixture of benzyl-chloride and methyl-iodide upon rosaniline dissolved in methylic alcohol (pure wood-naphtha). The new compound, a beautiful crystalline body, is the iodmethylate of the tribenzylated rosaniline, $C_{42}H_{40}N_3I = C_{20}H_{16}(C_7H_7)_3N_3.CH_3I$; it is formed according to the following formula:—

$$C_{20}H_{19}N_3,H_2O + 3C_7H_7Cl + CH_3I = C_{20}H_{16}(C_7H_7)_3N_3,CH_3I + 3HCl + H_2O.$$

The new compound alluded to was discovered by Herr F. Hobrecker, at Cretfeld,

Le Moniteur Scientifique Quesneville, April, 1873.

Means of Cooling the Air, and their Application in the Arts and in Domestic Life.—M. A. Jouglet.—A lengthy and rhetorical paper, more interesting in India than in England. The various modes of reducing temperature are examined in detail. The method of compressing air in large receivers, allowing the heat thus set free to be dissipated, and then allowing the air, in resuming its original volume, to render a portion of heat latent, is declared impracticable on the large scale. Evaporation as a mode of lowering temperature seems to find more favour in the eyes of the author, though he does not attempt to deny that an atmosphere saturated with watery vapour is oppressive, and often positively dangerous, from its power of checking insensible perspiration. The use of ice is impracticable, on account of its cost. Air has been cooled by forcing it through subterranean passages; this method is not merely costly, but suspicious, since in all cities the subsoil, to unknown depths, is contaminated with sewage matters, which would certainly taint currents of air driven through such tunnels. Double walls and roofs, between which currents of air are forced to circulate over wet surfaces, have also been suggested. An arrangement of this kind, with the inner wall and ceiling of sheet-iron, would probably be successful in tropical climates. Air has been drawn down a high shaft like a chimney, in the hope that it might prove cool. It need scarcely be remarked that, in hot weather, the temperature at the utmost height of such a shaft will be but slightly below that which prevails at 10 feet from the ground. The system which the author prefers is a machine for driving a current of air through a metallic plate pierced with fine holes, over which flows continually a thin stream of water. This, he states, will cool the air without dangerously increasing its amount of vapour. The author points out the valuable results which the power of lowering temperature at will would yield in hospitals, steamboats, breweries, wine cellars, chocolate works, sugar refineries, granaries, &c.

Determination of Phosphoric Acid in Substances of Agricultural and Physiological Importance.—M. H. Joulie.—We shall give this paper in an early number.

La Revue Scientifique de la France et de l'Etranger, April 3, 1873.

Contains no original papers relating to chemistry.

PATENTS.

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GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3803. Baron de Malorti, Jermyn Street, and J. E. T. Woods, West Kensington, Middlesex, "An improved process for preserving fresh meats, game, fish, and vegetables."—Petition recorded December 16, 1872.

846. H. Skoines, Argyle Street, King's Cross, Middlesex, "Improvements in the manufacture of gas, and in the treatment of the residues therefrom, and in the combination of gases for the production of light and heat, and in the apparatus employed therein."—Petition recorded March 8, 1873.

1007. G. Newton, Bow, Middlesex, "An improved lubricant."—Petition recorded March 19, 1873.

1043. N. Athow, Plaskynaston, Denbighshire, "Improvements in the production of colours for dyeing, printing, and staining."—Petition recorded March 20, 1873.

1055. P. Jensen, Chancery Lane, Middlesex, "Improvements in manures."—A communication from E. J. Erichsen, Copenhagen, Denmark.—Petition recorded March 21, 1873.

1105. E. C. Vickers, Clerkenwell, Middlesex, "Improvements in the preparation and treatment of paper to be used as a substitute for leather."

1106. A. M. Clark, Chancery Lane, Middlesex, "Improvements in the manufacture and preservation of beer, and in the treatment of yeast and wort, together with apparatus for the same."—A communication from L. Pasteur, Paris.—Petition recorded March 25, 1873.

1115. T. Maxted, Newnham, Kent, "Improvements in fuel and in the manufacture thereof."

1121. C. Roberts, F.R.C.S., Mayfair, Middlesex, "Improvements in the preparation of powders for the destruction of animal and vegetable parasites, applicable also as disinfectants and deodorisers."

1123. E. T. Moody, Templecombe, Somerset, "Improvements in the manufacture of illuminating-gas."—Petitions recorded March 26, 1873.

NOTICES TO PROCEED.

3813. A. M. Clark, Chancery Lane, Middlesex, "An improvement in artificial fuel."—A communication from E. F. Loiseau, Manch Chunk, Carbon, Penn., U.S.A.—Petition recorded December 16, 1872.

326. G. Haseltine, Southampton Buildings, London, "An improved process of converting cast-iron into steel, applicable to the manufacture of edge-tools."—A communication from T. H. Alexander, Washington, D.C., U.S.A.—Petition recorded January 28, 1873.

710. E. Metge and F. N. C. Vuibert, Boulogne-sur-Mer, France, "An improved mode or process of preserving meat."—Petition recorded February 26, 1873.

752. J. Buchanan, Hebburn, Durham, "Improvements in utilising alkali-waste in the manufacture or production of building materials."—Petition recorded March 1, 1873.

945. A. M. Clark, Chancery Lane, Middlesex, "Improvements in the treatment of peat for fuel, and in apparatus for the same."—A communication from J. F. F. Challeton, Paris.—Petition recorded March 14, 1873.

980. G. T. Bousfield, Sutton, Surrey, "Improvements in the manufacture of cheese."—A communication from H. O. Freeman, Sherbourne, New York, U.S.A.—Petition recorded March 17, 1873.

1046. J. Baggs, High Holborn, Middlesex, "Improvements in the manufacture of gas for illuminating and other purposes."—Petition recorded March 20, 1873.

PATENTS SEALED.

2941. G. Robbe, Fenchurch Street, London, "A medical preparation applicable to the treatment of what is known as 'foot and mouth disease' in cattle."—A communication from J. M. Brunet, Dieppe, France.—Dated October 5, 1872.

2959. W. Lorberg, North Bow, Middlesex, "A new or improved process for the manufacture of soap."—Dated October 8, 1872.

2974. B. Tanner, Liverpool, "Improvements in the manufacture of artificial manures."—Dated October 9, 1872.

3080. H. Bethell, Victoria Street, Westminster, "Improvements in the treatment of beer in order to prevent and remove acidity."—Dated October 18, 1872.

3585. F. M. Lyte, Asnières, France, "Improved process of treating and purifying crude phosphoric acid, and in the production of soluble phosphates, also for the manufacture of phosphorus and the treatment of certain residues resulting therefrom and phosphate of alumina."—A communication from H. Storck, E. Heutsch, A. Heutsch, A. Lutscher, and F. Grininger, Asnières, near Paris, France.—Dated November 28, 1872.

3643. F. J. Bolton, Grosvenor Mansions, Westminster, "Improvements in compounds for coating leather in order to render it more endurable and less pervious to moisture."—Dated December 3, 1872.

3957. J. W. Spencer, Newcastle-on-Tyne, "Improvements in the production of iron."—Dated December 24, 1872.

274. R. H. Patterson, Hammersmith, Middlesex, "Improvements in the purification of coal-gas, and in the production of alkaline sulphides to be employed for such purpose."—Dated January 23, 1873.

NOTES AND QUERIES.

Logwood Extract.—This has now become very extensively used in this country, but I cannot hear of it being manufactured, only in France and America. Often have I made enquiries about it, but as yet without any success.—J. H. B.

Derivatives of Methyl Hydride.—Ladenburg has been working upon very varied derivatives of methyl hydride; he is probably correct in regarding them all as conforming to the type of marsh-gas, C_2H_3,H (old notation). Can any reader kindly inform why one of these is called—

"Ortho-silico-propionic ether" $= Si_2(C_4H_5O_2)_3,E$,

and another—

"Ortho-silico-propionic acid methyl ether" $= Si_2(C_2H_3O_2)_3E$.

Also, why some of these bodies are *one vol.* hydrides instead of two?—S. E. P.

Manufacture of Sulphuric Acid.—As the manufacture of sulphuric acid has lately been a prominent subject in your journal, may I ask your practical readers a question relating to the mode of decomposing the nitrate of soda. Is there not a larger consumption of nitrate when the nitre-pots are heated by the hot gases from the burning pyrites in a chamber adjacent to the kilns, than when the pots are otherwise heated in a close oven, and the nitrous vapours conveyed separately to the tower or chamber—other circumstances being equal? In other words, in the first case, is not the sulphurous acid so hot as to deoxidise a portion of the nitrous vapour so completely that the latter loses its power of combining with the oxygen of the air, and transferring this to sulphurous acid?—A SUBSCRIBER.

MEETINGS FOR THE WEEK.

MONDAY, 21st.—London Institution, 4.
—— Medical, 8.
TUESDAY, 22nd.—Royal Institution, 3. Mr. Dannreuther, "On the Music of the Drama."
—— Civil Engineers, 8.
—— Anthropological, 8.
WEDNESDAY, 23rd.—London Institution, 7.
—— Society of Arts, 8.
THURSDAY, 24th.—Royal Institution, 3. Prof. Tyndall, "On Light."
—— Royal, 8½.
—— Royal Society Club, 6.
FRIDAY, 25th.—Royal Institution, 9. Prof. Flower, "On the Palæontological Evidence of Modification of Animal Forms."
—— Quekett Microscopical Club, 8.
SATURDAY, 26th.—Royal Institution, 3. Prof. Odling "On Ozone."

TO CORRESPONDENTS.

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J. B.—(1) Chloroform is the best softener. (2) Linseed oil and whiting.

J. Cox.—The solution of chloride of zinc should have the sp. gr. of 1·025.

J. McCulloch.—Your letter arrived too late for insertion this week.

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IV. The Planet Mars in 1873. By R. A. Proctor, B.A., Sec. R.A.S.
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VII. The Dolmen Mounds and Amorpholithic Monuments of Brittany. By S. P. Oliver, Capt. R.A., F.R.G.S.

The Reviews of Books include—"Our Seamen," by Samuel Plimsoll M.P. "The Eruption of Vesuvius in 1872," by Prof. Palmieri and Robt. Mallet, M.I.C.E., F.R.S. "The Geology of the London Basin," by W. Whitaker, B.A. "The Theory of Strains in Girders and Similar Structures," by B. B. Stoney, M.A. &c., &c.
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THE CHEMICAL NEWS.

Vol. XXVII. No. 700.

NOTE ON THE

ESTIMATION OF PHOSPHORIC ACID AS URANIC PHOSPHATE.

By ARCHIBALD KITCHIN.

The estimation of phosphoric acid as uranic phosphate is a method I believe rarely made use of by chemists, but which yields (with certain precautions) results quite as accurate as those obtained by the magnesium process, and possesses some advantages over the latter. First, the estimation can be conducted in the presence of lime, &c. Secondly, the precipitate is almost insoluble in water containing ammonium acetate, experiment showing that in water alone it is soluble to the extent of 1 part in 50,000; in water containing acetic acid it is rather less soluble, viz., 1 part in 67,000; and in water containing ammonium acetate and free acetic acid, 1 part in 330,000. Thirdly, the great atomic weight of uranium adds to the accuracy of the process, the ignited precipitate containing less than 20 per cent of P_2O_5. By most chemists the atomic weight of uranium is accepted as 120, and consequently, if the composition of the ignited precipitate be $(U_2O_3)_2P_2O_5$, the percentage of P_2O_5 present will be 19·78, but Fresenius and others take the atomic weight as 118·8, and the percentage of P_2O_5 in the ignited precipitate as 19·91; I think the following experiments tend to show the former is nearer the truth:—

Pure sodium phosphate in powder, and free from adherent moisture, was used; this salt, when dried and ignited, gave a residue weighing in two experiments 36·99 and 37·09 per cent respectively, the theoretical amount of $Na_4P_2O_7$ being 37·15 per cent. By the magnesium process it yielded in three experiments 19·91, 19·92, and 19·88 per cent of P_2O_5 respectively, theory being 19·83. This same salt gave by the uranium process results as stated in the following table. It will be seen that, when we take 120 as the atomic weight of U, the mean of the results is nearer to the theoretical percentage of P_2O_5 present in the salt than if we take the atomic weight as 118·8.

	$Na_2HPO_4+12H_2O$. Taken.	$(UO_2)_2P_2O_5$. Found.	Per cent of P_2O_5. Found. U = 118·8.	Found. U = 120.	Theory.
A.	1·2132	1·2173	19·97	19·84	19·83
B.	0·4847	0·4894	20·10	19·07	19·83
C.	1·3440	1·3495	20·00	19·86	19·83
D.	1·6848	1·6920	20·00	19·86	19·83
E.	0·4975	0·4997	20·00	19·86	19·83
F.	0·5295	0·5390	20·26	20·13	19·83
G.	1·2082	1·2075	19·90	19·77	19·83
		Mean ..	20·03	19·90	

In all the above cases, to the solution of the sodium phosphate in water, ammonia was added, and acetic acid to slightly acid reaction; the liquid was then brought to the boiling-point, and the uranic solution, in some cases acetate, and in others nitrate, added in slight excess. It was found that, if too much free acid was present, the precipitate took a much longer time to settle, and the supernatant liquid was not always clear; but, when the acetic acid was added to very faint acid reaction, the precipitate soon settled down, leaving a supernatant liquor quite clear and bright. "Fresenius" recommends the addition of a few drops of chloroform after precipitation, to cause the precipitate to settle more readily; but I have precipitated a great number of times, both with and without the after-addition of chloroform, and I cannot say that I have found it make any difference. The chief things required I believe to be a sufficient amount of ammonium acetate, and not too much free acid present; if these precautions are adopted, the precipitate settles in a few minutes. The washing is best done first by decantation, boiling up after each fresh addition of water, and lastly on the filter. After drying, the precipitate is strongly ignited until the filter is consumed; then a little nitric acid added, evaporated to dryness, and finally gently ignited; the residue should be of quite a yellow colour. If in the final ignition too much heat be applied, the uranic phosphate is reduced to a considerable extent, and turns a greenish colour; a second evaporation with nitric acid is then necessary.

Whitehaven, April 19, 1873.

ON THE

SEPARATION OF CAUSTIC SODA INTO PORTIONS OF DIFFERENT STRENGTHS ON PASSING FROM THE FUSED TO THE SOLID CONDITION.

By NICHOLAS GLENDINNING and ALFRED J. M. EDGER, Newcastle-on-Tyne.

When caustic soda, containing water in excess of the quantity corresponding with that of its hydration, passes from the fused to the solid condition, it separates into portions of different strengths.

In the manufacture of this article, when the batch has been brought to the required strength and condition, it is usual to pack it by pouring it whilst in the hot fluid state into iron casks or drums, wherein it solidifies on cooling. The sample is taken generally on a silver dish, or clean iron plate, during the packing process, and may be relied upon as accurately representing the mass; but a sample taken from the drum (after cooling) may, according to circumstances, differ from that taken during the packing operation by several per cents. As ignorance of this separation has frequently caused disputes between manufacturers and buyers as to the strength of the article, it may therefore be of some interest and value to those connected with its manufacture and consumption to learn the disposition of the various strengths in the drum, and the part from which a sample representing the average strength may be obtained. A drum of caustic soda, containing 66·8 per cent soda (Na_2O) and about 6 per cent water in excess of the water of hydration—as shown by the sample taken during packing—was cut through its centre transversely to its longitudinal axis, and samples taken as follows:—A, from the outside not extending more than 1 inch towards the centre; B, from a part about 5 inches nearer the centre; and C, from the centre. The radius of the drum was 11 inches. The following are the results:—

A.	B.	C.
66·9 p.c. Na_2O,	69·7 p.c. Na_2O,	61·6 p. c. Na_2O.

The outside, or A sample invariably agrees closely with the packing sample.

Analysis showed that the differences in strength of the samples taken from the drum are mainly attributable to water, but also in some measure to chlorides and sulphates, these bodies occurring in largest quantities in the C or centre sample.

The differences in strength, due to separation, will be greatly influenced by circumstances, *e.g.*, the quantity of water present, the temperature at the time of packing, and the size of the drum; but it is probable that caustic soda of very low strength (when such low strength is due to water) may not have this disposition to separate, as the temperature at the time of packing would be comparatively

low, and the solidification much more uniform throughout the mass.

We deem this separation due to the superior affinity for water possessed by the partially fluid caustic soda over that on the point of solidification.

ON THE CONSTITUTION OF AMYGDALIN.

By SAMUEL E. PHILLIPS.

The nitrogenous character of this glucoside places it out of the category of ordinary glucosides, and the difficulty herein is further enhanced by the statement of M. Schiff that it does not contain any ammonia, and that it is not an amide of amygdalic acid.

It is only after much study to trace its genesis as a cyanogen body, without any success, that we are compelled to fall back upon its ammoniacal character.

From this point of view we now try an application of the generic principles enunciated in a paper "On the Identification of Organic Radicals" (Chemical News, vol. xxvii., p. 99).

It is numerically immaterial whether we regard amygdalin sugar as 2 atoms of glucose or as 1 atom of diglucose; chemically, however, we prefer the latter alternative.

The acid, both chemically and otherwise, well accords with the formula of formic acid + almond oil − 2HO = $C_{16}H_6O_4$.

$$\left.\begin{matrix} C_{14}H_4 \\ C_2\ H_1O_2 \end{matrix}\right\} = (C_{16}H_5O_2)O + HO$$

This acid + sugar − 2HO = $C_{40}H_{26}O_{24}$ = amygdalic acid,

$$\left.\begin{matrix} C_{40}H_{20}O_{20} \\ C_{16}H_5\ O_2 \end{matrix}\right\} (C_{56}H_{25}O_{22})O + HO$$

The barium salt, $(C_{40}H_{25}O_{22})O + BaO$.

M. Schiff has obtained two acetic derivatives of this acid. Tetraceto-amygdalic acid = 4 acetic acid + amygdalic acid − 8HO =

$$\left.\begin{matrix} C_{40}H_{21}O_{22} \\ C_4\ H_3\ O_2 \\ C_4\ H_3\ O_2 \\ C_4\ H_3\ O_2 \\ C_4\ H_3\ O_2 \end{matrix}\right\} = (C_{56}H_{33}O_{30})O + HO$$

In obedience to well-marked analogies, I consider this a kind of anhydride to the actual acid of M. Schiff, which requires 4 more atoms of HO, and which may be pentabasic; hence the magnesia salt with 2½ atoms of diatomic magnesia!

The acid, $(C_{56}H_{33}O_{30})O + 5HO$

$(C_{56}H_{33}O_{30})O + 5MgO$

Heptacetoamygdalic acid = 7 acetic acid + amygdalic acid −

$$\left.\begin{matrix} 14HO = C_{40}H_{18}O_{22} \\ 7\ \text{acid} = C_{28}H_{21}O_{14} \end{matrix}\right\} (C_{68}H_{39}O_{36})O + HO$$

This requires 2 more atoms of HO to agree with the notation of M. Schiff, and it should be observed that though I have strictly followed M. Schiff's formula for the production of amygdalic acid, yet his context otherwise regards it $C_{40}H_{28}O_{26}$ or $(C_{40}H_{25}O_{22})O + 3HO$.

That I have rightly estimated the hepta radical is well confirmed by the heptacetyl-amygdalide of M. Schiff, which is $(C_{68}H_{39}O_{36})H_2N$; that is, $(C_{40}H_{25}O_{22})$, with 7 atoms of acetic radical replacing 7 atoms of H!

We now come to the ultimate nitro-product, which is—

Amygdalic acid + ammonia − 2HO =
amygdalin, $(C_{40}H_{25}O_{22})H_2N$.

Amygdalic acid + aniline − 2HO =
amygdalin-anilid, $(C_{40}H_{25}O_{22})PhHN$.

Amygdalic acid + 2 aniline − 4HO =
amygdalin-anilid, $(C_{40}H_{23}O_{20})Ph_2H_3N_2$.

Both these anilids are as yet hypothetic, but their production is a matter of great certainty, and the apparent anomaly herein becomes highly instructive. That his anilid should apparently contain a radical of $(C_{40}H_{23}O_{20})$, instead of $(C_{40}H_{25}O_{22})$, has been a standing perplexity, which is now fully resolved.

I gather from his able and extensive researches on gluco-ammonias and anilids that an hitherto-unobserved generic reaction subsists, in virtue of which the gluco-radical loses 2HO for every additional condensation of aniline or ammonia in the complex atom, whence the formula becomes—

Acid + aniline − 2HO = say, $(C_{40}H_{25}O_{22})Ph\ H\ N$

Acid + 2 aniline − 4HO = say, $(C_{40}H_{23}O_{20})Ph_2H_3N_2$

Acid + 3 aniline − 6HO = say, $(C_{40}H_{21}O_{18})Ph_3H_5N_3$

It will be found on examination that similar transpositions of radical are a wide and familiar feature in general chemistry. It is that by which morphia − 2HO becomes apomorphia.

Mannite, $(C_{12}H_{13}O_{12})O + HO - 2HO =$
Mannitan, $(C_{12}H_{11}O_{10})O + HO$.

Glycerine, $(C_6H_7O_4)O + HO - 2HO =$
Glyceride, $(C_6H_5O_2)O + HO$.

Glucose, $(C_{12}H_{11}O_{10})O + HO - 2HO =$
Glucosan, $(C_{12}H_9O_8)O + HO$.

Diglucose, $(C_{24}H_{21}O_{20})O + HO - 6HO =$
Caramel, $(C_{24}H_{15}O_{14})O + HO$.

Salicine, $(C_{26}H_{17}O_{12})O + HO + \text{aniline} - 8HO =$
$(C_{26}H_{11}O_6)PhHN$.

Phloridzin, $(C_{42}H_{23}O_{18})O + HO + 2\ \text{aniline} - 4HO =$
$(C_{42}H_{21}O_{16})Ph_2H_3N_2$.

In addition to these general cases, we now cite a few illustrations of the special character now under consideration.

Æsculin, $(C_{30}H_{15}O_{16})O + HO + \text{aniline} - 2HO =$
$(C_{30}H_{15}O_{16})PhHN$.

Æsculin, $(C_{30}H_{15}O_{16})O + HO + 2\ \text{aniline} - 4HO =$
$(C_{30}H_{13}O_{14})Ph_2H_3N_2$.

Æsculin, $(C_{30}H_{15}O_{16})O + HO + 3\ \text{aniline} - 6HO =$
$(C_{30}H_{11}O_{12})Ph_3H_5N_3$.

Æsculetine, $(C_{18}H_5O_6)O + HO + \text{aniline} - 2HO =$
$(C_{18}H_5O_6)PhHn$.

Æsculetine, $(C_{18}H_5O_6)O + HO + 2\ \text{aniline} - 4HO =$
$(C_{18}H_3O_4)Ph_2H_3N_2$.

Æsculetine, $(C_{18}H_5O_6)O + HO + 3\ \text{aniline} - 6HO =$
$(C_{18}H_1O_2)Ph_3H_5N_3$.

Caramel, $(C_{24}H_{15}O_{14})O + HO + 3\ \text{aniline} - 6HO =$
$(C_{24}H_{11}O_{10})Ph_3H_5N_3$.

Helicin, $(C_{26}H_{15}O_{12})O + HO + \text{aniline} - 2HO =$
$(C_{26}H_{15}O_{12})PhHN$.

Helicin, $(C_{26}H_{15}O_{12})O + HO + 2\ \text{aniline} - 4HO =$
$(C_{26}H_{13}O_{10})Ph_2H_3N_2$.

Tetraceto-helicin, $(C_{42}H_{23}O_{20})O + HO + \text{aniline} - 2HO =$
$(C_{42}H_{23}O_{20})PhHN$.

Tetraceto-helicin, $(C_{42}H_{23}O_{20})O + HO + 2\ \text{aniline} - 4HO =$
$(C_{42}H_{21}O_{18})Ph_2H_3N_2$.

Tetrabenzohelicin, $(C_{82}H_{31}O_{20})O + HO + \text{aniline} - 2HO =$
$(C_{82}H_{31}O_{20})PhHN$.

Tetrabenzohelicin, $(C_{82}H_{31}O_{20})O + HO + 2\ \text{aniline} - 4HO =$
$(C_{82}H_{29}O_{18})Ph_2H_3N_2$.

Tetraceto-esculin, $(C_{46}H_{23}O_{24})O + HO + 3\ \text{aniline} - 6HO =$
$(C_{46}H_{19}O_{20})Ph_3H_5N_3$.

Helicoidin, $(C_{52}H_{33}O_{26})O + HO + 2\ \text{aniline} - 4HO =$
$(C_{52}H_{31}O_{24})Ph_2H_3N_2$.

As to the saltic forms of these anilids—

The chloro-platinate of trianil-caramel =
$(C_{24}H_{11}O_{10})Ph_3H_6N_3Cl + PtCl_2$.

The chloro-platinate of trianil-esculin =
$(C_{30}H_{11}O_{12})Ph_3H_6N_3Cl + PtCl_2$.

The chloro-platinate of dianil-esculetine =
$(C_{18}H_3O_4)Ph_2H_4N_2Cl + PtCl_2$.

&c., &c.

We now revert to M. Schiff's amygdalin-anilid, which follows the law of the dianilids, but from the speciality of its formation it can only have 1 atom of the phenyl radical instead of 2.

It is amygdalin, $(C_{40}H_{25}O_{22})H_2N + \text{aniline} - 2HO =$
$(C_4\ H_{23}O_{20})PhH_4N_2$.

It is rather curious and may be somewhat instructive to notice that the nitrogenous glucoside of the Indigofera plant INDICAN — the sugar radical* + the 2HO necessary for the regeneration of the sugar (of which 1 H is retained to replace the lost radical) = INDIGO = $C_{16}H_5O_2.N$. And if amygdalin were similarly broken up the residue would be $C_{16}H_7O_2.N$.

As by the genetic antecedents of the latter, it would clearly be $(C_{16}H_5O_2)H_2N$, it will not be difficult to determine whether the former be $(C_{16}H_3O_2)H_2N$ or otherwise constituted!

We have inserted the saltic forms of dianils and trianils, as a rebuke to the modern doctrine that diamines are diatomic, and saturate 2 atoms of acid, and triamines 3 atoms, &c., &c.

The subject is referred to (CHEMICAL NEWS, vol. xxi., p. 289), and further investigation has fully established the welcome fact that a simple unity of principle pervades all such condensations, whether in alcohols or ammoniums.

In every case 1 H or equivalent is eliminated for every compound atom ingested, and the volume, type, and general character remain comparatively unaffected. A sevenfold condensed alcohol or ammonium, in either case, has 6 atoms of H eliminated!

Referring to the rosaniline varieties of so-called triamines, it is expressly said, "They do not form tri-acid salts." Indeed the sulphates and chloro-platinates correspond exactly with those now given from M. Schiff.

To such as patiently look forward for new proofs of a pervading unity in all natural phenomena, the transition from the present to a future chemistry may be hailed with high satisfaction.

* Indo-glucine $= C_{32}H_{33}O_{36}$ or $(C_{32}H_{32}O_{34}O) + HO$
Diglucose $= C_{24}H_{22}O_{22}$ or $(C_{24}H_{21}O_{21}.O) + HO$

The expressions, "agreeing with, or strictly following the formulæ of M. Schiff," must of course be understood as quite independent of his atomic weights and constitutional formulæ. His amygdalic acid is—

$$\left.\begin{matrix} C_6H_7.O\left\{\begin{matrix}(OH\\O\end{matrix}\right. \\ C_6H_7.O\left\{\begin{matrix}(OH)_3\\O\end{matrix}\right. \\ C_7H_6.O\left\{CO.OH\right. \end{matrix}\right\} = (C_{43}H_{23}O_{22})O + 3HO.$$

ON HETEROGENESIS.

By O. LOEW.

SOME time ago a work on spontaneous generation, by Dr. Bastian, made its appearance, and gave rise to much comment and criticism in scientific journals, as well as in the newspaper press. Recently, Mr. T. Burdon Sanderson published in *Nature* an account of his experiments made with the view to contradict Bastian's statements; but he had to acknowledge that, under the circumstances described by the latter, living bacterias were obtained. He boiled infusions of turnips with some cheese in a retort *for ten minutes*, and sealed the retort immediately. After a few days the contents of the retort were examined under the microscope, and living bacterias were recognised. To every reasoning mind it will be evident that those observations, called by Dr. Bastian "*De novo* production of living things," do not prove anything at all with regard to "heterogenesis."

Pouchet, Mallet, Wyman, and other exact observers, had, *long before Bastian*, published the same facts; but Pasteur, the great French *savant*, had demonstrated that living germs were always the cause of life in boiled solutions. I myself, six years ago, made many experiments in regard to this question. I heated infusions of hay, diluted solutions of glue, milk, &c., in sealed glass tubes, *up to* 150° *C. for one hour*, and exposed some of those tubes to the action of the sun-light; others, provided for the purpose with platinum wire, to the action of electric sparks; others, again, I kept in the dark. After three months I opened those tubes in the laboratory of the celebrated physiologist, Prof. Ludwig, in Leipzig, with great expectations. Nothing living was found, to my great disappointment. All these tubes, however, after being opened, soon developed bacterias.

After looking over all the facts found by Dr. Bastian, we must confess ourselves unable to form an idea of what "*Bastianism*" means, which word is made use of in *Nature*. We are now just as much in the dark about the question of the original formation of organisms as ever, for there existed certainly neither turnips nor cheese at the end of the Azoic period, or during the formation of the Potsdam sandstone.

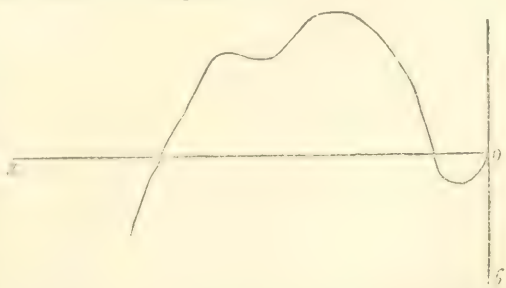
To any one who wants to gain information about all that has been done, and the experiments in regard to "heterogenesis," I recommend to study the very able article of Dr. H. Huppert, in "Schmidt's Jahrbücher für die gesammte Medicin," 1866. Bastian's work is simply the English translation of it.—*Engineering and Mining Journal.*

SOME RECENT RESEARCHES ON DIFFUSION OF GASES.

AT the last meeting of the Helvetic Academy of Sciences M. Dufour gave the principal results of an experimental inquiry into the variations of temperature which occur in diffusion of gases separated by a porous partition. He had studied, among other cases, those of hydrogen and air, of air and carbonic acid; and he distinguishes in these researches between diffusion at constant pressure and diffusion with varying pressure. A porous vessel containing the gas with slower diffusion (air or carbonic acid), and having a very sensitive thermometer applied to its inner surface, was placed in a larger and cloth-covered vessel, in which the other gas (hydrogen or air), was made to circulate. A glass tube through the stopper of the porous vessel communicated in some cases with the open air (constant pressure), and in others with a manometer. The thermometer was observed with a cathetometer.

It appears that with constant pressure (the glass tube communicating with open air) there is always elevation of temperature on the side of the entering diffusion, and lowering of temperature on the side where the diffusing gas issues from the partition. M. Dufour believes that this change of temperature is not produced throughout the whole gaseous mass, but only at the surface of the porous partition. He points out that at the side of entrance there is condensation, compression, and hence development of heat; while at the other, on the contrary, there is expansion of the gas, and so absorption of heat.

With varying pressure (the glass tube communicating with manometer) the phenomenon is more complicated. The indications of the thermometer are shown by the annexed curve, in which the abscissæ are the times, and the ordinates the temperatures.



M. Dufour also studied the diffusion between dry air and moist air. He found there was always a diffusion between two portions of air having different degrees of humidity; and, contrary to what might have been expected

from Graham's law (aqueous vapour being lighter than air), this diffusion was found to be from the dry to the moist air. The law of variation of temperature in this case agreed with what was previously observed in the case of the two gases. It is contrary to what might be supposed from a manometer communicating with the porous vessel. The phenomenon of diffusion between two such portions of air can be easily demonstrated with the aid of a water-manometer. It is even so sensible that M. Dufour thinks the principle might be adopted in hygrometry. There must obviously be many applications of this principle in the organic world.

A new phenomenon of diffusion, which connects itself with some of those above referred to, has recently been studied by Herr Feddersen of Leipsic, who describes his experiments on the subject in *Poggendorff's Annalen*.

While M. Dufour inquired into the variations of temperature produced by diffusion on the sides of a porous partition separating two gases, Herr Feddersen has examined the effect of producing a difference of temperature at the two sides of a porous partition separating two portions of the same gas. His method of experiment was as follows:—A porous stopper was inserted in a glass tube. The tube was placed horizontally, and the two ends projecting beyond the stopper were connected, air tight, by means of caoutchouc with other glass tubes also placed horizontally, in each of which a drop of liquid formed a *movable* stopper. Thus every propulsive movement of the column of air in the middle glass tube would cause a movement of the drops in the same direction. One end of the fixed stopper was then subjected to a constant source of heat, while the other remained cold or was artificially cooled: whereupon a slow passage of the column of air through the stopper was uniformly observed, having the direction from the cold to the warm end of the stopper.

Spongy platinum was the first material used as stopper; a piece of 60 m.m. length being introduced into a tube 3½ m.m. in diameter. Quicksilver was at first used for the drops, but this was found too little sensitive to the air motion. Hydrated sulphuric acid was substituted, and, with a temperature-difference in the stopper of 10° (that of the room) and 100°, a slow motion of the drops was distinctly observed. For example, in an eight hours' observation the drop moved away from the heated end about 195 m.m. This motion was somewhat irregular.

In a second form of the experiment a shorter tube, 12½ m.m. diameter, had introduced into it a stopper of newly-annealed spongy platinum 31 m.m. in length. The two other glass tubes were 3½ m.m. diameter. One end of the stopper was raised to a temperature of 200°, while the other was at the temperature of the room, 8° (though latterly it became hotter through conduction). The following table gives the numerical results from this experiment:—

Time.	Cold Side. Observation.	Cold Side. Calculated for 10 m.time.	Warm Side. Observation.	Warm Side. Calculated for 10 m.time.
12h. 0m. to 12h. 10m.	225 m.m.	225 m.m.	tube removed	—
12 10 ,, 12 15	94	188	95 m.m.	190 m.m.
12 15 ,, 12 25	tube removed	—	121	241
12 25 ,, 12 30	105	210	95	190
12 30 ,, 12 35	110	220	tube removed	—
Side tubes removed, and after an hour and a half replaced.				
2 0 ,, 2 5	73	146	49	98
2 5 ,, 2 20	203	137	153	102
2 20 ,, 2 30	151	151	112	112
2 30 ,, 2 35	76	152	58	116

After the last observation the bent extremity of the glass tube on the cold side was put in sulphuric acid. The motion of the drops presently ceased, when the acid had risen about 6 m.m.; and this condition continued some hours, till the apparatus was taken asunder. Thus, allowance being made for capillary action, the difference of pressure produced on the two sides of the stopper through differences of temperature would correspond to a column of sulphuric acid at least 5 m.m. in height.

Spongy palladium was next experimented with, the gas employed being hydrogen. By a peculiar arrangement of T tubes the gas was introduced both into the stopper tube and into the connected tubes. The results here obtained were extremely irregular, owing, doubtless, in part to the variable absorption by the palladium with variation of temperature, and in part to aqueous vapour produced by contact of hydrogen with the atmospheric air; nevertheless there was always some motion in the expected direction. The following is one example in which the dimensions were as in the last case, and the drops used were of oil:—

Time.	Cold Side.	Warm Side.
9h. 5m. to 9h. 25m.	130 m.m.	—
9 25 ,, 9 35	155	190 m.m.
9 45 ,, 9 50	45	Mouth in contact with oil surface in cup raises small bubbles.

Gypsum.—In a tube 12½ m.m. wide was inserted a stopper 70 m.m. long of gypsum, which had become quite dry through exposure in air. The glass tube at one end of the stopper was covered with copper and heated to about 200° by a spirit-lamp placed below it; while the other end of the stopper remained at 8°. The motions of the sulphuric acid drops here employed were as follows:—

Time.	Cold Side. Observation.	Cold Side. Reckoned for 10m. time.	Warm Side. Observation.	Warm Side. Reckoned for 10m. time.
10h. 15m. to 10h. 45m.	tube removed	—	60 m.m.	20·0 m.m.
10 45 ,, 11 30	,,	—	87	19·3
11 30 ,, 12 15	52 m.m.	11·5 mm.	45	10·0
12 15 ,, 1 15	52	8·7	32	5·3
1 30 ,, 2 0	20	6·7	23	7·7

Charcoal.—A stopper of charcoal 90 m.m. long was substituted for the gypsum. The sulphuric acid drop on the warm side did not at first move, while a quick motion of the other drop commenced at once. The table of numbers given by Herr Feddersen shows that the one drop was always more quickly moved than the other, whence it is inferred that, besides the phenomenon of the gas's movement in the tube, there was also a special absorption by the charcoal. A similar phenomenon had been observed with the platinum stopper, but the absorption was less in that case.

Silicic acid and *magnesia usta* were the remaining substances experimented with. In the case of the former, there was a slow motion of the drops, without indication of absorption of gas. A stopper of magnesia 40 m.m. long, in a tube 12½ m.m. diameter, gave the following results:—

Time.	Cold Side. Observation.	Cold Side. Reckoned for 10m. time.	Warm Side. Observation.	Warm Side. Reckoned for 10m. time.
7h. 30m. to 7h. 35m.	142 m.m.	284 m.m.	114 mm.	228 m.m
7 35 ,, 7 40	140	280	106	212

The numbers thus obtained for magnesia indicate an absorption of the gas.

From the foregoing experiments, it appears to be a common property of porous substances, when acting as a diaphragm in gas, to occasion a passage of gas from the cold to the warm side. This phenomenon of diffusion, unlike the ordinary diffusion, takes place when on both sides of the diaphragm there is the same gas with the same pressure. Herr Feddersen proposes to apply to it the name of *thermo-diffusion*.

He had not yet investigated whether this kind of diffusion was dependent on the nature of the gas, so that with mixed gases a selective diffusion might take place, *i.e.*, a mechanical separation of the gases similar to the separation produced in droppable fluids by diffusion. That such a phenomenon is not improbable appears, he thinks, from M. Dufour's experiments, and one fact observed by himself is favourable to the supposition. It is, that in the tubes a continuous decrease of motion was

perceived from the time of attachment; which must necessarily occur if, in the enclosed space on the cold side, one of the two constituents of the atmospheric air were more quickly diffused to the warm end than the other constituent; the enclosed space of that side must be sooner exhausted of the more readily diffusing gas than that of the other.

There is a reciprocity between Herr Feddersen's experiments and those of M. Dufour which is worthy of attention. And while the forces called into action in *thermo-diffusion* are probably very small, yet their influence in the economy of nature should not be overlooked.

A. B. M.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Ordinary Meeting, April 17th, 1873.

Dr. Odling, F.R.S., President, in the Chair.

The minutes of the previous meeting having been read and confirmed, Messrs. Charles T. Kingzett, C. H. W. Biggs, Andrew F. Crosse, and T. Futcher Best were formally admitted Fellows of the Society. The donations were then announced, after which Messrs. William Henry Greenwood and Walter Hills were proposed for election. The names read for the third time were those of Messrs. James Hughes and Henry Tylston Hodgson, M.A., who were balloted for and duly elected.

The President then called on Dr. Debus to deliver his lecture "*On the Heat Produced by Chemical Action.*"

The speaker, in his preliminary remarks, observed that the ideas of the majority of chemical investigators at any given time appeared to flow, as it were, in one great stream; thus, at the present time, there could be no doubt that the attention of chemists was mainly devoted to organic compounds. Ten or twelve years ago the type theory was prevalent: as soon as any new compound was discovered the question was asked, To what type must it be referred? Previous to that, it was the theory of organic radicals, and so on.

Now it was very useful occasionally to turn away from this main stream of thought, as it were, to one of the minor side currents in which but comparatively few chemists were making investigations; such a subject was the heat developed by chemical action, which he had chosen for consideration on that evening. About twenty years ago or more, Favre and Silbermann had found that the heat developed by the oxidation of the metals was, generally speaking, closely related to their chemical affinity; for instance, copper precipitates metallic silver from its solutions, and zinc, in its turn, precipitates copper; and we say that the chemical affinity of copper is greater than that of silver, whilst that of zinc again is greater than that of copper, and it is also found that more heat is developed in the oxidation of zinc than of copper, and by the oxidation of copper than of silver. Professor Andrews, by a series of careful experiments, further proved that the heat developed by combustion stands in a certain proportion to the chemical affinity, but the clearest expression of these facts has been more recently given by Professor Thomsen, of Copenhagen.

Let us consider for a moment the effect of heating, say, a gramme of water. According to the mechanical theory of heat, the work done may be divided into three parts:—(1) External mechanical work producing expansion; (2) the raising of the temperature; (3) certain molecular changes; the two last expressing the internal work done. The first effect of heat on the gramme of water is to cause its expansion, and at the same time the temperature rises until it reaches 100°, the temperature then remaining constant until the whole of the water has been converted into steam, the heat added to the water during this period having become latent, that is, has been employed in overcoming the cohesion of the molecules, so as to convert the water into vapour. If we continue the heating, the temperature again rises, and the steam continues to expand until at 1400° or 1500° it possesses the properties of a perfect gas. At a higher temperature, the molecules of water begin to decompose into hydrogen and oxygen, which at 2000° amounts to about two-thirds of the whole, whilst at a still higher temperature, probably about 3000°, the water is entirely resolved into its constituent elements. On allowing this mixture to cool to 1500°, the elements re-unite, and at the same time give out the heat they had previously absorbed, which is thus a true measure of the affinity between oxygen and hydrogen; and as the aqueous vapour thus formed condenses again into water, a further amount of heat is liberated, due simply to physical changes, so that, on burning a mixture of oxygen and hydrogen, the heat evolved is not simply a measure of their affinity, but is complicated by that due to certain physical changes. In the case of the combination of hydrogen and chlorine, however, to form hydrochloric acid, the heat evolved is far more nearly a measure of the affinity of the two elements, but not quite, since hydrochloric acid is not a perfect gas.

In considering the relation of the heat of combination and chemical affinity, we may lay down three general principles:—First, by the direct combination of the elements heat is always developed. There is one apparent exception, that of carbon disulphide; but this is accounted for on allowing for the different physical state of the liquid disulphide of carbon from that of the solid sulphur and carbon which produce it, and inversely on decomposing the compound into its original elements the same amount of heat will be absorbed or become latent. This is clearly seen in the thermic results of the action of aqueous hydrochloric acid on cupric oxide—

$$CuO + 2HClaq = CuCl_2aq + H_2O.$$

The heat developed by the union of copper and oxygen is 43,770 units, and of 2H, 2Cl, and water to form aqueous hydrochloric acid 2×39.315; the sum for the left-hand side of the equation being 122,400 units, whilst on the right-hand side we have $Cu + Cl_2$ in presence of water, which develops 69,000 heat units and $H_2 + O$, 68,300 − 15,270, due to the physical state of the water, making a total of 122,030 units, which is sensibly equal to that on the other side of the equation.

Again, the same amount of heat is developed in the formation of a compound, whether it be formed at once or by successive stages; thus, on burning carbon (charcoal) with sufficient oxygen to form carbonic oxide, 29,676 heat units are developed, and on burning the carbonic oxide thus formed to carbonic acid, 67,284 units more are developed, making a total of 96,960 units, which is precisely the same as that developed in burning charcoal directly to carbonic acid.

In certain cases, heat is rendered latent in the formation of compounds, but such combinations are never produced by direct union of their elements. Nitrous oxide, N_2O, is a substance of this class, and is always produced by the reduction of higher oxides of nitrogen. Graphite, when burnt to carbonic acid in nitrous oxide ($C + 2N_2O$), develops 134,000 heat units, and when burnt in oxygen ($C + O_2$) only 93,600, leaving a difference of 40,400 developed by the decomposition of the $2N_2O$; so that O, when it combines with N_2 to form N_2O, absorbs ½(40,400), or 20,200 heat units. A similar relation exists with potassium chlorate, and in a still more marked degree with potassium bromate, which, when gently heated with a very small amount of manganic peroxide, is decomposed with evolution of oxygen, and at the same time develops much heat; the action in the case of the bromate being almost explosive.

The lecturer, after showing that the so-called "Welter's law" is correct in comparatively few cases, proceeded to the consideration of the heat evolved by the oxidation of

the metals, which corresponds with the order of their affinity for zinc, iron, tin, lead, copper, mercury, and silver. In those elements which, like phosphorus, sulphur, and carbon, are susceptible of allotropic modifications, the heat of combustion is as their specific heats; thus charcoal, when burnt, evolves more heat than graphite. If we compare the heat evolved by the combination of any metal, say potassium, with chlorine, bromine, iodine, and sulphur, we shall invariably find that more heat is evolved in the formation of the chloride than in that of the bromide, and similarly, on comparing the bromide with the iodide, and the iodide with the sulphide; moreover, if the metals be arranged according to the amount of heat evolved in the formation of either the chloride, bromide, iodide, or sulphide, the order will always be the same, viz., that of their affinity. Further, supposing a metal, M, combines with chlorine and with bromine, forming the corresponding chloride and bromide, and that a second metal, M', also combines with chlorine and bromine, the thermic relation, expressed by the equation MCl – MBr = M'Cl – M'Br, is approximately true; for instance, zinc, in combining with chlorine, evolves 113,134 heat units, and with bromine 89,714, whilst lead similarly devolves 85,322 and 62,578 units. ZnCl (113,134) – ZnBr (89,714) = 23,420 heat units, and PbCl (85,322) – PbBr (62,578) = 22,744 heat units, numbers approximately the same.

After noticing the interesting results obtained by Professor Thomsen by the combination of hydrogen with the metalloids, the lecturer passed on to the heat evolved by the burning of organic compounds, noticing that isomeric bodies do not develop the same amount, as, for example, ethylene, C_2H_4, and paramylene, $C_{20}H_4O$, the former of which evolves 11,858 heat units, and the latter only 10,928. Moreover, it is not possible to calculate the amount of heat produced by the combustion of organic substances; thus, acetylene (C_2H_2) evolves 310,570 heat units when burnt, and two of hydrogen (H_2) evolve 68,357, the sum being 378,927. And we should expect that ethylene ($C_2H_4 = C_2H_2 + H_2$) would evolve this amount when burnt; but, in reality, we only obtain 334,800, being a difference of 44,122 units, which is, perhaps, expended in overcoming the affinity which unites the H_2 with the C_2H_2. By extending the numbers thus obtained to marsh-gas (CH_4) we may calculate the latent heat of carbon vapour in the following manner:—One molecule of solid carbon, on burning, will develop 93,600 heat units, and four of hydrogen 136,714, from which we must subtract $2 \times 44,122$, or 88,224 units, representing the heat absorbed in overcoming the affinity between the carbon and four of hydrogen contained in marsh-gas (CH_4), giving a total of 142,060 units; by experiment, however, we find that the combustion of marsh-gas develops 209,900 heat units. This difference of 67,840 units represents, therefore, the latent heat of carbon vapour.

In a series of homologous alcohols or acids, it would appear that the heat developed on combustion is less the higher we ascend in the series, that is to say, the more complicated the molecule becomes, which we may suppose to arise from the molecular work performed in packing the molecules more closely together, as it were.

The speaker finally made a few remarks on the thermic effects of solution, and of the combination of acids and bases, particularly drawing attention to the fact that, whenever a salt dissolves without producing a compound with the water in definite proportions, heat is absorbed; for example, on adding sufficient water to dry cupric sulphide or calcic chloride to form a crystalline salt, heat is developed, but, on dissolving the crystals so formed in water, heat is absorbed and the solution becomes colder, the molecular state of a solution differing from that of ordinary chemical combination. The fact that in double decomposition that compound is always formed which develops the greatest amount of heat is well exemplified by the action of hydriodic acid on argentic chloride, which, as is well known, yields argentic iodide and hydrochloric acid. Silver, in combining with chlorine, evolves 34,800 heat units, and hydrogen, combining with iodine in presence of water to form aqueous hydrochloric acid, develops 15,004, the sum being 49,804 units; on the other hand, silver, in combining with iodine, yields 18,651 units, and hydrogen and chlorine, in the presence of water forming aqueous hydrochloric acid, 40,192, the sum being 58,843 heat units. This amount of heat is greater than that developed in the former case, and therefore double decomposition takes place, with production of argentic iodide.

The thanks of the Society having been tendered to Dr. Debus for his interesting and instructive lecture, the President adjourned the meeting until Thursday, May 1st, when papers will be read "On Zirconia," by J. B. Hannay, and "On a New Class of Explosives," by Dr. H. Sprengel.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, April 1st, 1873.

R. Angus Smith, Ph.D., F.R.S., Vice-President, in the Chair.

Mr. J. S. Kipping and Mr. J. Sidebotham were appointed Auditors of the Treasurer's accounts.

"*Note on an Observation of a Small Black Spot on the Sun's Disc*," by Joseph Sidebotham, F.R.A.S.

As there is again some speculation as to the existence of an intra-mercurial planet, and every little fact bearing on the subject may be of value, I have referred to my diary, and find that on Monday, March 12th, 1849, our late member, Mr. G. C. Lowe, and I saw a small circular black spot cross a portion of the sun's disc. We were trying the mounting and adjustments of a 7-inch reflector we had been making, and used an ink-box between the eye-piece and the plane speculum. At first we thought this small black spot was upon the eye-piece, but soon found it was on the sun's disc, and we watched its progress across the disc for nearly half an hour. The only note in my diary is the fact of the spot being seen; no time is mentioned, but if I remember rightly it was about 4 o'clock in the afternoon.

Mr. Baxendell, on behalf of Mr. Sidebotham, F.R.A.S., exhibited a knife, the blade of which is steel, the bush at the handle brass, and the handle itself copper, all coated with nickel, beautifully polished. In a letter which Mr. Sidebotham had received from Professor Hamilton L. Smith, of Hobart College, Geneva, N.Y., the writer suggests the use of iron or bell-metal specula, coated with nickel, for reflecting telescopes. He says, "I ground and prepared a bell-metal speculum, which I coated with nickel, and this, when polished, proved to be more reflective (at least I thought so) than speculum metal. The two objects which I sought were—first, to have a polished surface unattackable by sulphuretted hydrogen (this, for example, is not injured by packing with lucifer matches); and, secondly, for large specula, doing most of the work by the turning-tool and lathe. I really think a large, say 3 feet, mirror, coated with nickel, but cast of iron, and finished mostly in the lathe, while it would not cost the tenth of a similar sized speculum metal, would be almost equal to silvered glass of the same size, and vastly more enduring as to polish.

Physical and Mathematical Section.

Annual Meeting, March 25th, 1873.

E. W. Binney, F.R.S., F.G.S., Vice-President, in the Chair.

The following gentlemen were elected officers of the Section for the ensuing year:—

President—Alfred Brothers, F.R.A.S.
Vice-Presidents—Joseph Baxendell, F.R.A.S.; Samuel Broughton.
Treasurer—Thomas Carrick.
Secretary—George Venables Vernon, F.R.A.S., F.M.S.

GLASGOW PHILOSOPHICAL SOCIETY.

(CHEMICAL SECTION).

Ordinary Meeting, April 14th, 1873.

Mr. JOHN JEX LONG, Vice-President, in the Chair.

THE PRESIDENT (Dr. Wallace, F.R.S.E.) read a paper on "*The Mortar of the Great Pyramid*," in which he gave a number of interesting details regarding the mortar employed in building the Great Pyramid; and incidentally referred to the composition of some mortars that he analysed a few years ago, including two from the exterior and interior of the Great Pyramid, two specimens of very ancient Phœnician mortar from the island of Cyprus, two from ruins at Athens, and from Rome and from other places in Italy. It was most interesting to observe the remarkable differences between the mortars of the various ancient peoples. By going to Baalbec and other ruined cities of Turkey in Asia, buildings might be found constructed of immense blocks of stone jointed with such excessive nicety that even the blade of a penknife could not be pushed between them, but without a vestige of mortar. In the structures of the ancient Egyptians, on the other hand, taking the Great Pyramid as an example, mortar was freely employed, but consisting almost entirely of gypsum or sulphate of lime. A specimen was examined from an ancient Phœnician temple, the highest stone of which was a few years ago 5 feet below the level of the ground at the time the specimen was taken. It was something like that found in some of the baronial castles in this country, and was like a piece of solid rock. The gentleman who brought it home supposed it to be the very oldest mortar in existence. If it were so, Dr. Wallace said that it was most remarkable, inasmuch as it was as perfect in constitution as it could possibly be, having been made evidently of burnt lime, fine sand, coarse sand, and gravel. It might be called concrete rather than mortar. At any rate, one thing was certain, namely, that the lime in it had become completely carbonated; and another specimen of the same age exhibited the same phenomenon, thus satisfactorily settling a point which was long in dispute. The ancient Greek mortars from ruins in the vicinity of Athens were also very perfect, but contained more lime than that from Cyprus, and no gravel. The mortars from various ruined buildings in Herculaneum, Rome, and its neighbourhood, appered to have been made from burnt lime and puzzuolana, or what is called by geologists volcanic ash. Dr. Wallace stated that he had had some correspondence with Professor Piazzi Smyth regarding the mortar of the Great Pyramid, some portions of which he read; and he gave the following analysis of a specimen which he had recently examined:—

Hydrated sulphate of lime	92·83
Carbonate of lime	4·63
Carbonate of magnesia	1·66
Alumina and traces of oxide of iron	0·24
Silica	0·88
Water (hygroscopic)	0·07
	100·31

In reply to a question, Dr. Wallace stated that he believed the sulphate of lime, which is abundant near the Pyramids, had been partly calcined, to drive off the water of hydration in the mineral, before being used in making the mortar. There was very little cohesiveness in the samples exhibited.

"*Lake Deposits from India.*"—Dr. WALLACE also gave a short account of several saliferous lake deposits from the East Indies, which had been sent to him for analysis with a view to advising as to their utilisation. The results of the examination were rather interesting. Lake deposits were known to occur in several countries—in Central Africa, in various parts of Asia, and in North and South America, where there are seasons of excessive drought, and where many salt-lakes have no outlet, not a few of them being far below the level of the sea. Examples were found in the Dead Sea, Lake Aral, and the Caspian Sea. The rivers flowing into such inland seas must necessarily carry various soluble salts, and these accumulate and ultimately crystallise out on the banks, or, if the lake becomes dry at any particular season of the year, they will form a crystalline deposit upon the surface of the bed of the lake. Dr. Wallace had no exact knowledge regarding the locality from which the salt deposits had been obtained, but he understood that they had been formed in the way just mentioned. The following are the analyses of four examples of the lake deposits:—

	Dulla Khar.	Nummuck Dulla.	Papree.	Bhooskee.
Soluble in water—				
Carbonate of soda (anhydrous) *.. ..	65·26	7·24	35·61	24·64
Carbonic acid in excess..	7·35	0·54	3·75	2·25
Carbonate of potash..	0·27	—	0·13	—
Chloride of sodium ..	0·60	86 66	39·21	20·17
Chloride of magnesium	0·67	traces	trace	trace
Sulphate of lime ..	traces	traces	trace	trace
Alumina and phosphate of lime.. ..	0·50	0·60	0·50	0·30
Insoluble—				
Carbonate of lime ..	1·80	1·13	3·95	2·20
Carbonate of magnesia				0·71
Oxide of iron				7·45
Alumina				5·35
Silica				14·45
Organic matter, chiefly insoluble	0·35	0·23	0·80	2·35
Water of crystallisation..	23·20	3·60	16·05	20·13
	100·00	100·00	100·00	100·00
* Equal to crystallised carbonate of soda..	17·60	19·50	96·10	66·50
Carbonate of soda ..	29·85	5·64	17·54	13·80
Sesquicarbonate ..	42·76	2·14	21·82	13·09

Dulla Khar.—Layers of hard crystals, mostly of a light brown colour, but some of greenish tint.
Nummuck Dulla.—An aggregation of large crystals of common salt of a rose-pink colour.
Papree.—Non-crystalline, and having more the appearance of a salt of lime than one of soda.
Bhooskee.—Of a light grey colour and earthy appearance.

The chief point of interest to chemists in the analysis of the deposit was the condition in which the soda existed. It was found that the text-books generally stated that the Trona of Egypt, and other saline deposits, consisted of sesquicarbonate of soda, but Dr. Wallace's analyses showed that the neutral and sesqui-carbonate were associated in very nearly equal quantities; and it appeared, likewise, that, under the circumstances in which the deposits were formed, a compound of soda was formed that contained very nearly 4 equivs. of soda to 5 equivs. of carbonic anhydride. In no case had Dr. Wallace found the soda and carbonic anhydride present in the proportions necessary to form either the neutral or the sesqui-carbonate. Some chemists who had examined somewhat similar deposits had given the soda entirely as sesquicarbonate, others had given it as neutral carbonate, but a few had given analyses corresponding with those of the author.

OBITUARY.

JUSTUS LIEBIG.

JUSTUS LIEBIG was born in the small German town of Darmstadt, on May 13, 1803, and educated in Bonn and Erlangen. He was originally intended for a pharmaceutist, but having found the means of visiting Paris, and passing some time in the laboratories of the great French chemists who flourished in the year 1823, and, having achieved a success as a chemist, he was at once enrolled by Humboldt in the ranks of the German professoriat, being in 1826 nominated Professor in Ordinary in the University of Giessen, after having for the two preceding years held office as Extraordinary Professor in the same university.

Liebig began to publish very early. In the *Annales de Chimie et de Physique* for the year 1823, tome xxiv., p. 294, there is a paper entitled "Mémoire sur l'Argent et le Mercure Fulminans, par le Dr. Justus Liebig." About the same period there is also a note by Dr. Liebig, "Sur une Couleur Verte," which is an account of some observations on the making of arsenite of copper. It appears, however, that there were some publications of still earlier date, inasmuch as he refers to his own work in Buchner and Kasner's journal.

The first publication, however, which excited attention was the one on the fulminates, which was first mentioned: Analyses of fulminate of mercury and fulminate of silver, and the preparation of most of the other fulminates, together with their analyses. We can understand that Humboldt was struck with the young chemist's ability who had accomplished such a task.

In his professorship at Giessen, Liebig displayed the greatest activity, and gathered around him a knot of men whose names are household words among chemists. It was in Liebig's hands that ultimate organic analysis assumed the importance which it has acquired; and it was mainly owing to him that it was so popularised among chemists as to become one of the commonest resources of the laboratory. In *Poggendorff's Annalen* for the year 1831 may be read Liebig's own account of his improvements in the management of a combustion and in the apparatus. The following passage, which is exquisitely pithy and exquisitely modest, winds up the description:—"In this apparatus there is nothing new but its simplicity and thorough trustworthiness."* The paper is a study of chemical method, and might be read with advantage by chemists living in the year 1873. We must, says Liebig, separate the determination of nitrogen from the determination of carbon, and make two distinct and independent analyses. We must have a method which admits of operating on 3 or 4 grms. of substances which are poor in carbon, and on ½ to 1 grm. of substances which are rich in carbon. Liebig chose to weigh the carbonic acid instead of to measure it. In 1831 the measurement of gases was a matter of much greater difficulty than it is to-day, and the advantage gained at that period, by making the common combustion not to involve a gaseous measurement, was more striking than it is at present. Still, even to-day, there would be no gain in the substitution of measurements of carbonic acid for weighings of it, and the belief which some chemists entertain, that there would be, has its origin only in mental confusion and want of appreciation of the practical conditions under which analyses are accomplished and limited.

Much of that which is best established and most familiar to us in organic chemistry is the work of Liebig, and was accomplished long ago. The constitution of chemical history of benzoic acid was made out by Liebig and Wöhler. Hippuric acid was explored by Liebig. Aldehyde, which previously bore the name "light oxygen ether," and was known only in a very impure condition, was first rendered intelligible by him. Tyrosine, sarcosine, and creatinine, which are derived from flesh, are his discoveries. Though not the originator of the theory of compound radicals, he was one of its most powerful supporters, and contributed much of that which has proved to be most enduring in it. The theory of the existence of the radical ethyl is Liebig's, and the splendid investigation which led its authors to speak of the radical benzoyl was conjointly Liebig's and Wöhler's.

The application of chemistry to agriculture, and to many of the wants of daily life, received so powerful an impulse from Liebig, that the popular mind has taken him for the representative of the science in its application to practical purposes. So great, indeed, has his fame become as a technologist, that writers in English newspapers have overlooked the fact that he was one of the greatest chemists of the century.

Liebig left Giessen in the year 1852, and went to Munich, where he became Professor of Chemistry in the University and President of the Academy of Sciences. In 1845 he had been created a Baron. He died at Munich on the 18th of this month.

* "An diesem Apparate ist nichts neu als seine Einfachheit und die vollkommene Zuverlässigkeit, welche er gewährt.

DR. H. BENCE JONES.

We have to announce the death, on the 20th inst., after a long, and latterly, severe illness, of Dr. Bence Jones, the Secretary to the Royal Institution. Dr. Jones was a distinguished chemist; among his contributions to the advancement of science may be mentioned his Croonian Lectures "On Matter and Force," "Animal Chemistry in relation to Stomach and Renal Diseases," "Lectures on Pathology and Therapeutics," &c. His treatise on the early history of the Royal Institution, and his valuable biography of Faraday, are amongst the latest of his works.

In our issue of March 21st, we announced the fact of a movement being set on foot to get up a testimonial to Dr. Jones, which, in agreement with his own wishes, will take the form of a bust to be placed in the Royal Institution.

CORRESPONDENCE.

MANUFACTURE OF SULPHURIC ACID.

To the Editor of the Chemical News.

SIR,—In reply to Dr. Lünge's observations on the above subject (CHEMICAL NEWS, vol. xxvii., p. 163), I beg to inform him, so far as his personal remarks are concerned, that Messrs. Allhusen's *is not* the only manufactory in which I have had experience in the manufacture of sulphuric acid, as I have had the advantage of being for a number of years engaged in many parts of both Great Britain and Ireland in the erection of such plant, and in some instances starting it to work; and that the acid plant with Glover towers, to which he refers as my knowing nothing about, was erected from plans prepared exclusively by myself, and the principal erections put up under my personal superintendence. I agree with him as to the ease with which chambers worked with Glover towers can be started by the use of an "extra quantity of nitre," but contend that those worked on that system require this "extra quantity" much longer than the others. This at first sight may appear trifling, but in reality is very serious, when from 10 to 12 per cent of nitre on the sulphur charged has to be used for days in place of from 3 to 4 per cent.

I still admire the rule-of-three where it can be applied with advantage, but in the case as shown by me it gives erroneous results, and therefore is no guide at all. The correct estimation of the nitrous compounds in the acid is a problem which has not yet been satisfactorily solved, and I, with your readers, will be happy to have the method

from which Dr. Lünge and his friends derive such great comfort in keeping their chambers in good working order.

I would also take this opportunity of pointing out a typographical error. In vol. xxvii., p. 137, twenty-seventh line from bottom, the figures 52·947 should be read as a whole number.—I am, &c.,

James McCulloch.

PURIFYING CAUSTIC SODA.

To the Editor of the Chemical News.

Sir,—The mode of purifying caustic soda described by Dr. Lünge to the Newcastle-upon-Tyne Society, and consisting in blowing air into the soda when in the dry fusion state, is by no means new. I invented and carried out into working order the same process in 1865, since which time it has been in constant use at these works under my superintendence. I noticed, at the time Mr. Helbig's specification was published in this country, the most remarkable similarity to my method, even to the caoutchouc tube. I have used the term "my method" for convenience only, as in fact the method was patented in 1860 by W. Ralston, of Keele, Newcastle-under-Lyne, dated November 22, printed in "Repertory of Patent Inventions," June 1, 1861, page 496. This latter, and to me disagreeable, fact I only discovered when about to patent the invention myself. That the method has merits is, I think, being shown by the fact of a considerable portion of the trade adopting it.

Will you here allow me to correct an error which has crept into my previous letter, and which considerably alters the sense of the concluding paragraph. A single letter only has been left out. What I intended saying was that the bichromate method of estimating tin was in use in "this" (*i.e.*, Ardwick Bridge Chemical Works) laboratory, not "his," *i.e.*, Dr. Penny's laboratory, as I am made to say, in the early part of 1850.—I remain, &c.,

Peter Hart.

Ardwick Bridge Chemical Works,
Manchester.

MISCELLANEOUS.

Appointment of Analyst for Sheffield.—At a meeting of the Sheffield Town Council held on the 9th inst., Mr. Alfred H. Allen, F.C.S., was elected Public Analyst for the borough by 39 votes to 13. The salary is £100 per annum. Mr. Allen is Lecturer on Chemistry at the Sheffield School of Medicine, and has given considerable attention to the detection of adulterations.

Royal Institution of Great Britain.—The following are the lectures to be delivered at this Institution, each lecture commencing at three o'clock:—E. Dannreuther, Esq. (three lectures), "On the Development of Modern Music in connection with the Drama, with Illustrations on the Pianoforte;" on Tuesdays, April 22, 29, and May 6. J. H. Parker, Esq., C.B. (four lectures), "On the Evidence for the Traditional History of Rome from Existing Architectural Remains;" on Tuesdays, May 13, 20, 27, and June 3. Professor Tyndall, LL.D., F.R.S. (six lectures), "On Light;" on Thursdays, April 24 to June 5. Professor Odling, M.A., F.R.S. (four lectures), "On Ozone;" on Saturdays, April 26 to May 17. John Morley, Esq. (three lectures), "On the Limits of the Historic Method;" on Saturdays, May 24, 31, and June 7. To the Friday Evening Meetings, Members and their friends only are admitted; the discourses will probably be as follows:—April 25th, Professor Flower, F.R.S., "On Palæontological Evidence of Gradual Modification of Animal Forms;" May 2, Professor J. Emerson Reynolds, M.D., "On New Alcohols from Flint and Quartz;" May 9, M. E. Grant Duff, Esq., M.P., "A Fortnight in Asia Minor;" May 16, Professor Sidney Colvin, M.A., "On the Limits of Certainty in Taste, or in Artistic Judgment;" May 23, W. Spottiswoode, Esq., M.A., LL.D., Treas. R.S. and R.I., "On Spectra of Polarised Light;" May 30, the Earl of Rosse, D.C.L., F.R.S., M.R.I., "On the Radiation of Heat from the Moon, the Law of its Absorption by our Atmosphere, and its Variation in Amount with her Phases;" June 6, Professor Odling, M.A., F.R.S.

Metropolitan Gas Supply.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has recently reported to the Corporation of London and the Metropolitan Board of Works on the quality of the gas supplied by the Chartered, the Imperial, and the South Metropolitan Gas Companies during the last three months. Dr. Letheby states that the average illuminating power of the Chartered Company's gas at the several testing places has been as follows:—At Beckton, North Woolwich, 17·41 standard sperm candles; at Cannon Street, City, 17·22 candles; at Friendly Place, Mile End, 17·12 candles; and at Arundel Street, Haymarket, 16·78 candles. The gas of the Imperial Company has had an illuminating power of 17·30 candles at Carlisle Square, Chelsea; 16·07 candles at Camden Street, Camden Town; and 15·63 candles at Graham Road, Dalston. The average power of the South Metropolitan gas has been 15·79 candles; and the power of the cannel gas of the Chartered Company has been equal to 24·99 candles. As regards purity, Dr. Letheby reports that with one exception the gas at all the testing places has been constantly free from sulphuretted hydrogen, and that the average amount of sulphur in the gas of the several companies has been as follows:—11·76 grains per 100 cubic feet in the Beckton Gas, 9·42 grains in that at Friendly Place, 15·42 grains at Cannon Street, 18·02 grains at Arundel Street, and 16·12 grains at Millbank. The gas of the Imperial Company contained 32·11 grains per 100 cubic feet at Carlisle Square, 2946 grains at Camden Street, and 30·47 grains at Graham Road. The average amount of sulphur in the gas of the South Metropolitan Company was 36·11 grains per 100 cubic feet. With respect to this impurity, the referees have notified in their recent instructions for the gas examiners that the maximum amount of sulphur allowable in the gas of the several companies shall be 20 grains per 100 cubic feet of gas. This applies at the present time to the gas made at Beckton and Bow, and will apply to the gas made at other works after the 30th of June next. The amount of ammonia in the gas has not in any case exceeded 2 grains per 100 cubic feet of gas, and has averaged from 0·02 of a grain to 0·56.

Anthracene Blue.—A few years since aniline was the great source of new and beautiful colours. Now that every possible shade of colour, surpassing in number and beauty the hues of the rainbow, have been produced from aniline, the chemist has taken up the study of anthracene and alizarine, also coal-tar products. While preparing artificial alizarine from anthracene, Springmühl has obtained a by-product, from which he has made a beautiful blue colour, superior in some respects to any of the aniline blues. The process by which it was prepared he keeps a secret. Dried *in vacuo*, it is a blue powder with a few little crystals. In this it differs from the aniline dyes, which are one colour when dry, another when in solution. When pure hot water is poured over anthracene blue it mostly dissolves, but leaves a little insoluble residue. The addition of an alkali destroys its colour, which is restored, however, by an acid. The strongest mineral acids are unable to destroy its colour, but rather heightens its tone. Unlike aniline dyes, it is insoluble in alcohol and ether. Experiments show that it withstands the action of light better than aniline blue. Unfortunately, it is at present very expensive, for Springmühl obtained but 2·5 grains of anthracene blue from 25,000 grains of anthracene, which makes it cost about 3000 dols. per pound at present. A cheaper method of making it is certainly desirable.—*American Artisan.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, April 7th, 1873.

Becquerel on Electric Capillary Batteries and their Action.—The principle of electro capillary action consists in a property of the moist sides of capillary spaces; in virtue of which they conduct electricity like solid conducting bodies, whence result currents which produce in these spaces metallic reductions and other chemical actions. Such an electro-capillary element consists of an eprouvette containing a solution of nitrate or sulphate of copper, into which passes a slit-tube containing a solution of monosulphide of sodium. Into this enters another tube closed at its lower end with a spiral roll of paper, and containing a saturated solution of nitrate or sulphate of copper. Into the closed tube is introduced a slip of copper connected with a thin sheet of the same metal enveloping the outside of the slit tube. The latter is thus in communication with the deposit of copper formed in the crack by electro-capillary action. A battery formed of such elements is useful for producing slow, constant action. In the second part of this memoir the author shows the electro-capillary actions produced when a precipitate moistened with water, or with a solution, is in contact with a sheet of metal, more or less oxidisable, placed between two plates of glass, and cemented on the edges to prevent, as far as possible, the evaporation of water and the entrance of air. All the chemical effects produced are due to the joint action of affinities and of electro-capillary currents springing from the oxidation of the metal. In operating upon a zinc plate with chromate of lead moistened with distilled water, there were formed bibasic chromate of lead, more or less crystalline, and chromate of zinc. Using iron in place of zinc, the result was still bibasic chromate of lead in acicular crystals, ferric oxide, magnetic oxide in brilliant scales, mixed with chromate of iron and oxide of lead. Crystalline double oxalate of potash and copper was formed in an apparatus consisting of a tube closed at one end with parchment-paper, and containing a saturated solution of nitrate of copper, and of a beaker filled with a solution of potassic oxalate, into which the tube was plunged. The double oxalate was found in crystals on the exterior side of the paper, whilst the tube contained nitrate of potash. These researches lead the author to examine the opinions of physicists and chemists on the nature of affinities. He sums up his observations as follows:—In the molecular changes and chemical transformations of bodies we find produced calorific, electric, and sometimes luminous effects, which become the causes of affinities; but are the forces which produce them derived from the same principle and mutually convertible? If the same effect is produced in bodies, is the sum of the calorific or electric action constant? It is not proved. Heat and light are probably due to a vibratory movement communicated to the particles of bodies, but nothing gives a distinct indication that this is also the case with electricity and magnetism. When bodies are heated their volume changes, and reciprocally when their volume is changed thermic effects result. When there is no alteration in the state of aggregation the duty executed is equivalent to the heat emitted or absorbed. When molecular changes take place, they correspond to the amount of heat absorbed or emitted. In chemical actions we observe also thermic effects, but they only indicate the consequence of complex results, such as the mutual approximation or separation of molecules, especial groupings, &c. As to the disengagement of electricity in the changes of the state of aggregation of bodies nothing is ascertained. When bodies are unequally heated, if they are liquid no thermo-electric effect is observed. If solid, and if the parts in contact differ in nature, such effects become sensible. Still they are not energetic, and cannot serve to measure the effects produced. With metals those which have the highest specific heat are electro-positive. In the chemical action due to electricity, contrary to what is the case with heat, the laws are more simple, for each equivalent of electricity decomposes an equivalent of a compound body submitted to its action. The electro-capillary actions due to the joint influence of electricity, affinity, and molecular attraction introduce a new element into the question. If it is possible in certain cases to measure chemical action by the calorific effects produced, nothing similar can be done with the two electricities set free under the same circumstances, as they follow all conductors present, and even the extremely minute films of moisture adhering to non-conductors in order to re-constitute the "neutral fluid." These re-compositions, after producing electro-capillary currents, take part in chemical reactions, and complicate the question of affinities. It may be remarked, further, that in chemical reactions produced with the aid of heat, such as fusion, nothing proves that there may not be electro-capillary currents acting as chemical forces—a question which will be treated in a future memoir.

Production of Ozone by Electric Action.—By M. A. Boillot.—A current of dry air gave a mean of 20 to 21 milligrms. of ozone to 5 litres of air, which corresponds approximately to 1 litre of oxygen. A current of oxygen in the same conditions gave 7 milligrms. per litre. In further experiments the precaution was taken to remove any nitrogen compounds by passing the air through a solution of caustic potash. The results were unaltered. Hence oxygen, in the condition in which it exists in the air, is more readily transformed into ozone in the proportion of 3 to 1 than pure oxygen gas. Another theoretical conclusion deducible from the above experiments is, that ozone cannot be a combination of oxygen with itself. The combination of several atoms of oxygen to form ozone seems to me to be a hypothesis no longer capable of being sustained.

Note on a Series of Artificial Gems Presented to the Academy.—Ch. Feil.—Fragments of pale rose-coloured matter fused by the aid of borax, and stated as composed of almost pure alumina, when illuminated by sunlight in the phosphoroscope, emitted a bright red light, the spectrum of which differed little from that of the light emitted by the ruby.

Note on the Effects Produced by Electric Currents on Mercury Submerged in Different Solutions.—Th. du Moncel.—A physical examination of the movements of mercury under the above circumstances.

Note on the Solvent Action of Glycerine on the Metallic and Calcareous Oleates, and on Sulphate of Lime.—E. Asselin.—Pure glycerine free from lime, of the sp. gr. 1·114, dissolved 0·71 per cent of iron soap, 0·94 of magnesia soap, and 1·18 of lime soap. The metallic and earthy sub-soaps, which impregnates the fibre of wool in the process of combing, are easily emulsified by water mixed with glycerine. Sulphate of lime dissolves in glycerine to the extent of 0·957 per cent, and the amount dissolved increases with the temperature.

Action of Chloride of Chloracetyl upon Aniline and Toluidine.—D. Tommassi.—Aniline and toluidine, under the influence of the chloride of chloracetyl, exchange an atom of hydrogen for an atom of chloracetyl, and give rise to two new crystalline products—phenyl-chloracetamide—

$$\left.\begin{matrix} C_6H_5 \\ H \\ C_2H_2ClO \end{matrix}\right\}N$$

and benzyl-chloracetamide—

$$\left.\begin{matrix} C_7H_7 \\ H \\ C_2H_2ClO \end{matrix}\right\}N$$

The former compound forms fine crystalline needles in an aqueous solution. It fuses at 97° C., and sublimes at high temperatures. Ether and acetic acid dissolve it in the cold to a large extent. Sulphuric and hydrochloric acid dissolve it easily when hot. Boiling nitric acid converts it into a new nitrogenous compound not yet analysed. Benzyl-chloracetamide crystallises in prismatic needles, which sublime at 110°, and fuse at 162°. It is insoluble in cold, and very sparingly soluble in boiling water. Sulphuric and acetic acids dissolve it sparingly in the cold, but freely when hot. In hydrochloric acid it is insoluble. By nitric acid it is converted into a nitro derivative.

Note on the Poisonous Effects of the Iodides of Tetramethyl-Ammonium or Tetramyl-Ammonium.—M. Rabuteau.—A physiological investigation. The iodides above mentioned destroy animal life by paralysing the nerves of motion; and their effects are, therefore, completely analogous to those of Curere or Wourali.

Revue Hebdomadaire de Chimie Scientifique et Industielle, February 13, 1873.

This number contains no paper of any chemical interest.

La Revue Scientifique de la France et de l'Etranger, April 12, 1873.

Professor Mascart contributes a long essay on theories in chemica instruction.

Annalen der Chemie und Pharmacie, No. 3, March 24, 1873.

This number contains the following original memoirs and papers:—

Studies on the Alkaloids contained in the Cinchona Barks. O. Hesse.—This exhaustive monograph contains a most complete historical, pharmacognostical, and chemical *resumé* of all that relates to this subject. The essay, though not suited for abstraction, is an excellent quinological *vade-mecum*, and a valuable contribution to the literature on the cinchona alkaloids.

On Aurine.—R. S. Dale and C. Schorlemmer.—After referring to the earliest discovery of aurine by Kolbe and Schmitt (1861), to the labours of these chemists, and also of Fresenius, the authors state that Fresenius's coralline and their aurine are not identical. They then proceed to detail first, the method of purification of the commercially made aurine, and next, quote the properties of this body in pure state. It is crystalline, soluble in alcohol, acetic and hydrochloric acids, fusion-point 220°; the aurine is also soluble in alkaline solutions which exhibit a brilliant fuchsia colour. Acids precipitate from these solutions a crystalline powder. Formula of pure aurine, $C_{21}H_{16}O_3$. The following combinations are further described:—Aurine-sulpho-dioxide, $2(C_{21}H_{16}O_3)SO_2+5\frac{1}{2}H_2O$; aurine-potassium-bisulphite,—

$$C_{21}H_{16}O_3+KHSO_3;$$

aurine-ammonium-bisulphite; leukaurine, the product of the action of iron and acetic acid upon aurine, $C_{21}H_{18}O_3$; triacetyl-leukaurine, $C_{21}H_{16}O_3(C_2H_3O)_3$; tribenzyl-leukaurine; coralline (Fresenius's). Aurine prepared from pure phenol differs from the aurine obtained

from that made commercially, and also differs from Fresenius's coralline. Pæonine is the product of the action of liquid ammonia upon aurine at from 140° to 150°.

Isuretin—a Basis Isomeric with Urea.—W. Lossen and P. Schifferdeoker.—Isuretin—$NH_2O + CNH = N_2CH_4O$—is the product of the action of hydrocyanic acid upon hydroxylamine. This exhaustive essay treats on—Preparation and properties of isuretin, which is a solid crystalline body, readily soluble in warm water, and more readily so in alcohol, fusion-point 104° to 105°, but partial decomposition sets in. Salts of isuretin, viz., hydrochlorate, sulphate, acid oxalate, neutral oxalate, picrate. Products of isuretin when decomposed by heat; action of dilute acids on isuretin; decomposition of isuretin by water; attempted conversion of isuret into urea; products of decomposition of isuretin are formic acid, ammonia, hydroxylamine, nitrogen, carbonic acid, urea, biuret, guanidin, and ammelid. Constitutional formula of isuretin—

$$C\overset{\equiv N}{\underset{H}{<}} + H.NH.OH = C\overset{=NH}{\underset{H}{<}} NH.OH$$

On Parabanic Acid Hydrate.—B. Tollens and R. Wagner.—This paper treats chiefly on the best method of preparation of the parabanic acid hydrate, viz., by the mild action of moderately strong nitric acid upon uric acid. The authors recommend the use of 3 parts of nitric acid (sp. gr. 1·3) to 1 of uric acid, care being taken that by the gradual mixing of these substances the temperature do not rise above 50°.

Monograph on Mellithic Acid.—A. Bayer.—This is the second instalment of a treatise, this section being mainly devoted to the polycarbon acids of benzols.

Phenanthren—a New Hydrocarbon from Coal-Tar.—R. Fittig and E. Ostermayer.—This paper, which has also been published in the *Ber. d. Deutsch. Chem. Gesells.*, is a more extensive essay on this subject.

Glyco-sulpho-urea.—J. Volhard.—The contents of this paper chiefly bear upon the fact that the author, previous to Maly's communication on this subject (*Anzeiger der K. Akad. d. W. zu Wien.*, No. 6, 1873), had already obtained this new compound, but with somewhat different results.

NOTES AND QUERIES.

Action of Heat on Gems.—Can any of your readers kindly describe the effect produced upon the sapphire and the emerald respectively when exposed to the oxyhydrogen flame?—X.

Perfect Vacuum.—Some years ago I remember seeing a description of an experiment by which it was shown that a really perfect vacuum would not conduct the electric current. I require to obtain a perfect vacuum for some experiments in which I am engaged, and I should feel greatly obliged if some of your obliging correspondents would give me a description of the mode of exhausting tubes to such a high degree. I believe Dr. Andrews was the one who described the method, and he employed potash and carbonic acid. The experiment was subsequently exhibited by Mr. Grove at a Friday evening lecture at the Royal Institution.—F.R.S.

Separation of Woollen from Cotton Fibre.—(Reply to "Subscriber.")—In the ordinary processes for recovering unmixed fibre, animal or vegetal, from rags of mixed tissues, one of the interwoven materials is sacrificed in order to obtain the other separately for use. Thus, if it be wished to recover the wool of mixed woollen and cotton rags, the mass is treated with a dilute solution of hydrochloric acid, which destroys the vegetal fibres of the tissue without sensibly affecting the wool. Many thousand tons of "shoddy" are made every year by tearing up in special machines, called "devies," the woollen threads thus recovered from mixed rags of wool and cotton stuffs, a class of rags technically termed in the rag trade "shallies." Rags of this class, when boiled in an alkaline, instead of an acid, solution, are disintegrated as to their woollen ingredient, while their cotton threads remain perfectly unaltered; and these latter are strained from the wool solution, washed in several waters to remove the last traces of animal matter, and then sold as raw material to the paper-maker, who further washes and bleaches them by the methods employed in bleaching ordinary coloured cotton rags. To avoid the necessity of thus sacrificing one material in order to serve the other, as also for the purpose of economising the consumption of costly chemicals in so doing, Mr. F. O. Ward some years ago devised a process by the use of which *both* classes of ingredients, the animal and the vegetal, are recovered in a saleable form, each product fetching in the market at least double the rate of price at which the raw material is obtainable. In this system, moreover, the only chemical agent used is water in the condition of steam. The effect of the steam upon the wool is to reduce it to a varnish-like coagulum—tough and tenacious while damp, but easily rendered brittle and friable by desiccation. The dried mass is beaten and tossed in rotating sieves, through which the woollen product falls as a fine powder rich in ammonia, and therefore very valuable as an agricultural fertiliser. Any fibres of *silk* and scraps of old *leather* as may be present in the mixed mass undergo the same transformation as the wool, and augment the weight and volume of the manurial product. The cotton threads, on the contrary, together with any flax, hemp, or other vegetable fibres that may chance to be present, are retained as fibre within the sieve, and sell as a paper material, of medium quality, ranking with the class of material known in the rag trade by the technical appellation "colours." Manufacturers desirous of practising this process should consult the chapter upon it in the "Chemical Jury Report of the International Exhibition of 1862," where a detailed description of the method is given; and fuller minutiæ could no doubt be furnished by the originator of the system, Mr. F. O. Ward, of London.—Technologist.

Experiments to Determine the Density of the Earth.—The following extracts from the paper on the above subject, by Henry Cavendish, Esq., F.R.S. and A.S., read before the Royal Society, June 21, 1798, and published in the *Philosophical Transactions* for 1798, will be read with interest, inasmuch as they show, not only the great care with which this important experiment was performed, but also point to some anomalies of disturbing force which have not even yet been satisfactorily explained:—

Pp. 469-470.—The leaden balls were 2 inches diameter, and were attracted by leaden weights 8 inches diameter. "The force with which the balls are attracted by these weights is excessively minute, not more than $\frac{1}{50,000,000}$ of their weight." "It is plain that a very minute disturbing force will be sufficient to destroy the success of the experiment; and, from the following experiments it will appear, that the disturbing force most difficult to guard against, is that arising from the variations of heat and cold; for, if one side of the case is warmer than the other, the air in contact with it will be rarefied, and in consequence, will ascend, while that on the other side will descend, and produce a current which will draw the arm sensibly aside."*

P. 484.—"These experiments are sufficient to show, that the attraction of the weights on the balls is very sensible, and are also sufficiently regular to determine the quantity of this attraction pretty nearly, as the extreme results do not differ from each other by more than $\frac{1}{10}$th part. But there is a circumstance in them, the reason of which does not readily appear, namely, that the effect of the attraction seems to increase, for half an hour, or an hour, after the motion of the weights. . . . . The first cause which occurred to me was that possibly there might be a want of elasticity, either in the suspending wire, or something it was fastened to."

P. 489.—"In the fourth experiment, the effect of the weights seemed to increase on standing, in all three motions of the weights, conformably to what was observed with the former wire; but, in the last experiment, the case was different; for though, on moving the weights from positive to negative, the effect seemed to increase on standing, yet, on moving them from negative to positive, it diminished." "My next trials were to see whether this effect was owing to magnetism. . . . "

P. 491.—". . . . The effect produced could not be owing to magnetism."

"The next thing which suggested itself to me was, that possibly the effect might be owing to a difference of temperature between the weights and the case; for it is evident, that if the weights were much warmer than the case, they would warm that side which was next to them, and produce a current of air, which would make the balls approach nearer to the weights. Though I thought it not likely that there should be sufficient difference, between the heat of the weights and case, to have any sensible effect, and though it seemed improbable that, in all the foregoing experiments, the weights should happen to be warmer than the case, I resolved to examine into it, and for this purpose removed the apparatus used in the last experiments, and supported the weights by the copper rods, as before; and, having placed them in the midway position, I put a lamp under each, and placed a thermometer with its ball close to the outside of the case, near that part which one of the weights approached to in its positive position, and in such manner that I could distinguish the divisions by the telescope. Having done this, I shut the door, and some time after moved the weights to the positive position. At first, the arm was drawn aside only in its usual manner; but, in half an hour, the effect was so much increased, that the arm was drawn fourteen divisions aside, instead of about three, as it would otherwise have been, and the thermometer was raised near 1½°. On opening the door, the weights were found to be no more heated, than just to prevent their feeling cool to my fingers."

"As the effect of a difference of temperature appeared to be so great, I bored a small hole in one of the weights . . . . and inserted the ball of a small thermometer. . . . . Another small thermometer was placed with its ball close to the case. . . . ."

Experiments here follow, from which (expt. 6) the air therm. was 0·3° colder than the weight therm.; from expt. 7 the air therm. was 0·4° colder than the weight therm.; and from expt. 8 the air therm. was 0·5° colder than the weight therm.—(Pp. 493-495.)

P. 496.—"In these three experiments" (6, 7, and 8) "the effect of the weight appeared to increase from two to five tenths of a division, on standing an hour; and the thermometer showed, that the weights were three or five tenths of a degree warmer than the air close to the case. In the two last experiments, I put a lamp into the room, over night, in hopes of making the air warmer than the weights, but without effect, as the heat of the weights exceeded that of the air more in these two experiments than in the former."

Here follows a description of an experiment in which the weights were warmed by lamps. When 6° warmer than the air, "the arm was drawn aside about four divisions more, after the weights had remained an hour in that position, than it was at first."—(P. 496.)

In another experiment (p. 496), when the weights were "scarcely 2° warmer than the case," "the arm was drawn aside about two divisions

* "M. Cassini, in observing the variation compass placed by him in the Observatory (which was constructed so as to make very minute changes of position visible, and in which the needle was suspended by a silk thread), found that standing near the box, in order to observe, drew the needle sensibly aside; which I have no doubt was caused by this current of air."—P. 471.

more, after the weights had remained an hour in the position they were moved to, than it was at first."

(P. [illegible].—"On May 23rd the experiment was tried in the same manner, except that the weights were cooled by laying ice on them; the ice being confined in its place by tin plates, which on moving the weights, fell to the ground, so as not to be in the way. On moving the weights to the negative position, they were found to be about 8° colder than the air, and their effect on the arm seemed now to diminish on standing, instead of increasing, as it did before; as the arm was drawn aside about 2½ divisions less, at the end of an hour after the motion of the weights, than it was at first."

"It seems sufficiently proved, therefore, that the effect in question is produced, as above explained, by the difference of temperature between the weights and case; for, in the 6th, 7th, and 8th experiments, in which the weights were not much warmer than the case, their effect increased but little on standing; whereas it increased much, when they were much warmer than the case, and decreased much, when they were much cooler."

"It must be observed, that in this apparatus, the box in which the balls play is pretty deep, and the balls hang near the bottom of it, which makes the effect of the current of air more sensible than it would otherwise be, and is a defect which I intend to rectify in some future experiments."—(P. 497.)

"Each of the weights weighs 2,439,000 grains."

"Each of the balls weighs 11,262 grains."

On p. 520 are given densities of earth calculated from 29 experiments. The mean of these is 5·48. The lowest is 4·88, and the highest 5·85.

P. 521.—"From this table it appears, that though the experiments agree pretty well together, yet the difference between them, both in the quantity of motion of the arm and in the time of vibration, is greater than can proceed merely from the error of observation. As to the difference in the motion of the arm, it may very well be accounted for, from the current of air produced by the difference of temperature; but, whether this can account for the difference in the time of vibration, is doubtful. If the current of air was regular, and of the same swiftness in all parts of the vibration of the ball, I think it could not; but as there will most likely be much irregularity in the current, it may very likely be sufficient to account for the difference."

P. 521.—". . . . It, indeed, may be objected, that as the result appears to be influenced by the current of air, or some other cause, the laws of which we are not well acquainted with, this cause may perhaps act always, or commonly, in the same direction, and thereby make a considerable error in the result. But yet, as the experiments were tried in various weathers, and with considerable variety in the difference of temperature of the weights and air, and with the arm resting at different distances from the sides of the case, it seems very unlikely that this cause should act so uniformly in the same way, as to make the error of the mean result nearly equal to the difference between this and the extreme; and, therefore, it seems very unlikely that the density of the earth should differ from 5·48 by so much as 1-14th of the whole."

P. 522.—"Another objection, perhaps, may be made to these experiments, namely, that it is uncertain whether, in these small distances, the force of gravity follows exactly the same law as in greater distances. There is no reason, however, to think that any irregularity of this kind takes place, until the bodies come within the action of what is called the attraction of cohesion, and which seems to extend only to very minute distances."

MEETINGS FOR THE WEEK.

MONDAY, 28th.—Geographical, 8.30.
—— Medical, 8.
—— Philosophical Club, 6. (Anniversary).
—— London Institution, 4.
TUESDAY, 29th.—Royal Institution, 3. Mr. Dannreather, "On the Music of the Drama."
—— Civil Engineers, 8.
—— Zoological, 1. (Anniversary)
WEDNESDAY, 30th.—London Institution, 12. (Anniversary).
—— Society of Arts, 8.
—— Geological, 8.
THURSDAY, May 1st.—Royal Institution, 2. (Anniversary).
—— Royal, 8½.
—— Chemical, 8, J. B. Hannay, "On Zirconia." Dr. Sprengel, "On a new Class of Explosive."
—— Royal Society Club, 6.
FRIDAY, 2nd.—Royal Institution, 9. Prof. Reynolds, "On Alcohols from Flints."
—— Geologists' Association, 8.
SATURDAY, 3rd.—Royal Institution, 3. Prof. Odling "On Ozone."

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MUTUAL DETERMINATION OF THE CONSTANT OF ATTRACTION, AND OF THE MEAN DENSITY OF THE EARTH.

By A. CORNU and J. BAILLE.

SINCE the discovery of the law of universal gravitation, it has been for astronomers and physicists an important problem to determine the numerical value of the constant expressing the reciprocal attraction of two units of masses placed at a unit of distance. The third law of Kepler would enable us to obtain directly the value of the total mass of two bodies reacting one upon the other, from a knowledge of two elements of their relative motions, the half-major axis of the orbit, and the period of a revolution if the value of this constant were known. The method of the deviation of a plummet proposed by Bouguer and La-Condamine only yielded, in the hands of Maskelyne, approximate results. The balance of torsion appears more accurate. The first experiments made with this instrument were planned by Mitchell and executed by Cavendish in 1798. The investigations were resumed by Reich, of Freyberg, in 1838; the principal improvement which he introduced consisting in the addition of a mirror for the measure of the deviations. The authors considered that the importance of the subject, to physics and mechanics as well as to astronomy, made further research desirable, especially as the experimental method employed is applicable, not merely to measuring the constant of attraction, but to a number of other physical determinations.

They commenced with a complete study of the torsion balance, especially as regards absolute measurements. The points especially studied are, besides the conditions of arrangement of the suspending wire, the lever, &c., the annulment of the most important causes of perturbation, and the law of the resistance of the air. The chief results have been the following:—The law of the atmospheric resistance is that in a space sufficiently extended the resistance is proportional to the speed, which permits the correction of the perturbations occasioned, and further, in a practical point of view the reduction, by a suitable form of the lever, of the coefficient of extinction of the oscillations due to this cause.

After these preliminaries the authors constructed apparatus to measure the constant of gravitation and the density of the earth, endeavouring to make arrangements differing as widely as possible from those of their predecessors, in order to vary the conditions of the experiment. The lever of the torsion-balance is a small tube of aluminium 50 centimetres in length, bearing at each extremity a ball of copper weighing 109 grms. A plane-mirror fixed in its middle renders it possible to observe with a lens a scale placed 5·60 metres off. The torsion wire is of silver, being 4·15 metres high. It has been fixed since September, 1871. The time of a double oscillation of the lever is 6 mins. 38 secs.

The attracting mass is formed by mercury contained in two hollow spheres of cast-iron. By aspiration the mercury can be passed from one of these spheres to the other, so as to double the effect of attraction.

The principal improvements as compared with the apparatus of Cavendish, Reich, and Bailey, are the reduction of the dimensions to one-fourth. It will be seen in examining the formula expressing deviation that this reduction is advantageous, for in apparatus geometrically similar (the time of the oscillation of the lever remaining the same) the deviation is independent of the weight of the suspended balls, and in the inverse ratio of the homologous dimensions.

The attracting mass has, therefore, been reduced to 12 kilos., in place of twice 158 kilos. as employed by Cavendish. The employment of mercury permits the displacement of the attracting mass without shock or vibration, which renders inversion very easy. Electric perturbations were eliminated by the metallic structure of all parts of the apparatus, and by their constant communication with the soil. Finally, the electric registration of the complete law of the oscillatory movement of the lever enables the observer to dispense with counting the time, and renders it possible to preserve in the form of graphic representations all the circumstances accompanying the observation. Two numerous series of observations were made in summer and in winter. The series of summer gave—

$$\Delta = 5{\cdot}56$$

That of winter—

$$\Delta = 5{\cdot}50.$$

The results confirm the number found by Cavendish. The authors conclude from these researches that the mean density of the earth is 5·56.

ON THE DECOMPOSITION OF METALLIC CARBONATES BY HEAT.

By L. JOULIN.

THE substance, as dry as possible, is placed in a tube of glass 2 cubic metres in diameter, to the ends of which were fused at right angles two narrower tubes communicating, the one with a syphon-gauge, and the other with Alvergniat's mercurial pump; by means of which a vacuum can be formed, and the gas collected. A bulb filled with chloride of calcium had been arranged between the syphon-gauge and the decomposition-tube, in order to absorb the last traces of moisture which may exist in the substance. The space for gas to collect is 197 c.c. The part of the tube containing the substance is immersed in a bath of oil, the temperature of which is kept constant by means of a Friedel's regulator. The substance having been placed in the apparatus, a current of dry carbonic acid is passed over it for twelve hours. Then the gauge is filled, and the temperature of the oil-bath having been raised to 80° C., two exhaustions were made before observing the tensions, in order to eliminate all the gas that the pulverulent substance might have condensed.

Carbonate of manganese was produced by the reaction of equal equivalents of chloride of manganese. It was washed very many times by decantation, and dried at 66°, and cooled in an exsiccator under a bell-glass. 16 grms. of the precipitate were successively exposed for several hours to the temperatures 100°, 150°, 200; 100°, 100, 300°; each heating being preceded by a longer or shorter cooling. The results were that the carbonate of manganese was very perceptibly decomposed at 70° C. Up to 200° C. the decomposition presented the two characteristics of the phenomenon which Deville has named dissociation. That is, at a given temperature the tension of the carbonic acid reaches a value (215 m.m. at 150°), which remains constant within the limits of time of the operation, and that during the period of cooling the tension of the gas returns by degrees to its primitive value in consequence of the re-combination of the carbonic acid and protoxide of manganese. The limit of tension seems to decrease with the temperature. It is feebler at 200° than at 150°

From 250° to 300° the elastic force of the carbonic acid has increased constantly to 2 atmospheres. As the pressure-gauge did not go further, it was supposed that complete decomposition was commencing, a view confirmed by the fact that during the period of cooling the re-absorption was very slight. The substance, which remained white up to 200°, was turned brown at higher

temperatures, the protoxide of manganese having decomposed a little of the carbonic acid in order to convert itself into sesquioxide, as Debray found was the case with carbonic acid and the protoxide of iron. On analysis it was actually found that a part of the gas consisted of carbonic oxide. The substance successively heated to 100°, 150°, 200 was, after cooling, heated anew to 100°; and it was found that at this temperature the tension limit of the gas was less than the half of what it had been when the substance was heated to 100° for the first time (315 m.m.); in the third heating the limit remained the same (145 m.m.) as in the second. This phenomenon can only be explained by molecular changes which the carbonate of manganese had undergone in the successive heatings. Thus such pulverulent bodies would suffer a series of pseudo allotropic modifications.

Decomposition of Carbonate of Silver.—The decomposition of the oxide of silver was first studied. It was found that up to 250° the tension of the oxygen yielded by the oxide is very feeble, lower than 15 m.m. The decomposition of the carbonate can, therefore, be studied up to 200°. Complete decomposition takes place between 250° and 300°.

The study of the decomposition of the carbonate of silver has given results decidedly different from those yielded by the carbonate of manganese.

Lead.—Experiments made upon 13 grms. of cerussite (native carbonate of lead) have proved that the tension of the carbonic acid coming from its decomposition, very feeble (below 30 m.m.) at 150°, rises to 75 m.m. at 250°, and increases very rapidly at 300°, the temperature of complete decomposition, which at a pressure of 2 atmospheres was reached in two and a half hours.

All these experiments, which show the extreme instability of metallic carbonates, throw some doubt as to the analyses upon which H. Rose founded his theory of the hydrocarbonates. He has given no indication of the manner in which he dried his precipitates. The author concludes that at temperatures higher than 50° or 60° there is no security against the disengagement of carbonic acid.

ON THE CHARACTERISTIC PROPERTIES OF THE COMMON OILS.

By M. G. GLŒSSNER.

AFTER having reviewed the characters of the various fatty non-drying oils (olive, almond, rape, sesame, palm), and of the drying (linseed, poppy, castor), the author tabulates the properties by which they may be recognised.

Action of Potassa in the Cold.—We agitate 5 volumes of the oil with 1 volume of potassa of sp. gr. 1·34. The mixture is:—

White—Almond, rape (best), bleached olive.
Yellowish—Poppy, olive, rape, sesame.
Greenish—Linseed, hemp. Oils containing copper, or artificially coloured.
Rose—Rape (refined).
Brown and compact—Hemp.
Yellow-brown and liquid—Linseed.
Red—Whale.

The oil is poured in a test-tube upon an equal measure of fuming nitric acid. There appears at the surface of separation a narrow transparent green zone—Almond.

Deep green, with a rosy halo at top—Poppy.
Clear blue-green—Olive.
Reddish brown—Linseed. After some time, the colouration extends to all the oil.
Green and red at the upper part—Rape.

Action of Concentrated Sulphuric Acid (10 drops of oil to 2 of acid).—Colour at the surface of separation:—

Fine green, with brown stripes—Rape.
Yellow, passing into olive-green when stirred—Poppy (*Media sativa*).
Red stripes, shading into black—Whale.

Equal volumes of acid and of oil dissolved in bisulphide of carbon:—

Fine violet colouration passing into brown—Whale.

Same proportions, without sulphide of carbon:—

Deep green colouration—Rape, linseed, hemp.
Red colouration—Whale.

Reaction of Elaidine.—The mass becomes solid, clotty, and white—Olive, almonds, rape (bleached). Ordinary rape oil gives a yellowish mass.

Red solid mass—Sesame.
Waxy white mass—Castor.
The mass of elaidine traversed by oily striæ—Mixture of drying oils.
No action—Linseed, poppy, nut.

Ebullition with Water and Litharge:—

Solid plaister—Olive.
Viscous plaister—Rape, almonds, sesame.
Viscous plaister, growing hard in course of time—Drying oils.

Solubility in Alcohol.

Olive	1 : 1
Poppy	1 : 25
Hemp	1 : 30
Linseed	1 : 40
Almonds	1 : 60

Specific Gravities.

Poppy, Rape	0·913
Almond (*Brassica campestris*)	0·914
Olive	0·918
Sesame	0·923
Sunflower	0·926
Castor	0·950—0·960
Linseed	0·930

Melting-points.

	Degrees.
Hemp	−27
Castor	−18
Linseed	−16 to −20
Sunflower	−16
Rape	−6
Brassica campestris	−4
Sesame	−5
Olive	2·5
Almond	−20 to −25

ON THE PROBABLE EXISTENCE OF MICROSCOPIC DIAMONDS, WITH ZIRCONS AND TOPAZ, IN THE SANDS OF HYDRAULIC WASHINGS IN CALIFORNIA.

By Prof. B. SILLIMAN.

THE occurrence of diamonds of some size in the gold fields of California is by no means uncommon, and was noticed by me in a communication to the California Academy of Science in 1867, when specimens of this gem, from at least five different localities, were exhibited. I then suggested that a more attentive examination of the heavy sands left in the sluices of hydraulic washings would in all probability detect diamonds, mingled with other rare species not commonly believed to occur in these sands.

Mr. George A. Treadwell, of San Francisco, has lately sent me a small package of these sands, collected by him from the sluices of the "Spring Valley Gravel Mining Claim," Cherokee, Butte County, California. A microscopic examination shows these sands to abound in beautiful colourless zircons (hyacinths), of the form well known in the hyacinths of Expailly (France), associated with crystals of topaz, quartz in fragments, rounded

grains of chromic and titanic iron, and a few small, almost globular, masses of very high refracting power which appeared to be diamonds. To determine this chemically, a portion of the sands was treated with acid for the removal of any carbonates which might be present. There was no effervescence from this treatment. The same sample was then digested in strong sulphuric acid of a high temperature to destroy any particles of organic matter which might be present, washed out in pure water without contact with organic matter, dried, and ignited in a vessel of platinum out of contact with air. This sample of the sands thus freed from anything which could afford carbonic acid, but the diamond, was then ignited in a platinum nacelle (boat) in a tube of hard glass, and in a current of pure dry oxygen gas, which, for precaution, was passed over soda lime, and then, after passing the ignited assay, was delivered through a solution of baryta water. The transparency of this delicate test was soon disturbed, and by continuing the experiment for about an hour, a notable quantity of baryta carbonate was obtained. This experiment seems to prove that diamond powder was present in small quantity.

It will be remembered that Prof. Wöhler, some years since, found diamonds by a similar method in the platinum sands from Oregon, associated with the rare species *Laurite* —sulphide of osmium and ruthenium.

The black grains, which contribute fully one-half the bulk of the Butte County sands, are about equally chromic iron, which the magnet removes, and titanic iron, which is unaffected by the magnet. The chromic iron was so proved by the blowpipe, and no magnetite could be detected. No metallic grains of any of the platinum or iridosmium metals, or gold, could be found.

Under polarised light, these crystalline sands form a splendid microscopic object.

When I am provided with a larger quantity of these sands, I propose to determine the amount of diamond dust quantitatively.

In his letter to me, accompanying the sample sent, Mr. Treadwell says:—"I have examined much of the sand under the microscope, and think there are a few fragments of broken diamonds. These sands were taken from the tailings after passing through a long flume paved with stone. You know what sharp and hard pounding the gravel gets, mixed with boulders, in a hydraulic flume. No doubt some diamonds are ground, or rather broken, by hard knocks to powder."

A more attentive observation, by a mineralogical eye, of the sands accumulating in the sluices of hydraulic washings will, no doubt, be rewarded by the discovery of many rare species, which have thus far escaped notice for want of scientific skill. To show how much may be learned from an attentive study of such sands, Dr. John Torrey has informed me that in a sample of sands from gold washings in Nicaragua, he has found not less than twenty distinct mineral species, many of them of rare occurrence. No doubt a careful examination of the sands of Oregon, where Dr. Trask found the platinum minerals, would reveal many unsuspected species.

INVESTIGATIONS ON PARA-SULPHOBENZOIC ACID.

By IRA REMSEN.

A SHORT time ago I commenced a series of investigations the object of which was to throw additional light upon the subject of "molecular re-arrangement in aromatic compounds." I was guided by the hope that many, if not all, of those cases of apparent anomaly, which had been referred to molecular re-arrangement, might by a careful re-examination find other and more satisfactory explanations; and that this inexplicable and dangerous bugbear might, in consequence, be forced at least from that division of organic chemistry which comprises the so-called aromatic compounds. Up to the present the object in view has hardly been approached, inasmuch as attractive byeways were soon disclosed, and these were followed. Leaving then for a future paper the consideration of the subject mentioned above until its study shall have become more complete, I shall here give a description of one of the byeways which drew me away from the main road.

I. *Para-Oxybenzoic Acid from Sulphobenzoic Acid.*

A most glaring case of apparent molecular re-arrangement is that noticed in connection with the formation of proto-catechuic acid from oxybenzoic and para-oxybenzoic acids; and the formation of pyrocatechin (and only this) by the dry distillation of protocatechuic acid. To this case I have already referred,* and it was, indeed, for a short time the subject of a discussion,† which ended temporarily in an unsatisfactory manner. I hope by its further study to be able to come to a definite conclusion in regard to it. My attention was at first directed to the study of the oxybenzoic acid from which the protocatechuic acid had been prepared. Adopting the method which had already been employed for the preparation of this acid, I converted a quantity of benzoic acid into sulphobenzoic acid, and melted the potassium salt of this latter with potassium hydroxide. On extracting the product in the usual manner by means of ether, and crystallising it from water, I was astonished to find that on cooling, well formed, slightly coloured crystals were deposited from the solution, instead of the crystalline mass or verrucous masses characteristic of oxybenzoic acid, which I anticipated. The general appearance of these crystals led immediately to the conclusion that in this case para-oxybenzoic acid had been formed, and further examination showed this to be true. The substance was re-crystallised from water, and then possessed all the characteristics of a pure chemical compound. The crystals were now colourless, and sharply defined in form; they were transparent, but, on being heated to 100° in an air-bath, they became opaque, the presence of water of crystallisation being thus indicated. The fusing-point was found to be 210° in repeated experiments, and decomposition took place when the crystals were heated slightly above the fusing-point; the point of solidification was 160°. All these properties taken together prove that the substance under consideration is not oxybenzoic acid, and the proof that it is para-oxybenzoic acid was rendered complete by the analysis, which gave the following results:—

I. 0·3308 grm. substance, heated to 110°, lost 0·0383 grm. H_2O.

II. 0·2925 grm. dried substance gave 0·6502 grm. CO_2 = 0·17733 grm. C, and 0·1181 grm. H_2O = 0·01312 grm. H.

	Calculated.		Found.
C_7	84	53·85	53·61
H_6	6	3·84	3·97
O_3	48	30·77	
H_2O	18	11·54	11·58
	156	100·00	

Para-oxybenzoic acid, then, according to this, can be the product of the action of potassium hydroxide on sulphobenzoic acid. But this reaction has been employed for the preparation of pure oxybenzoic acid—first by Barth,‡ and afterward by Heintz,§—and, as neither of these chemists mention the formation of para-oxybenzoic acid under these circumstances, it is fair to suppose that, if formed, it escaped their attention; that it could not have made its appearance in such quantities as in the experiment described is evident. The question now naturally arose, whether the conditions under which I had prepared

* *Zeitschrift fur Chemie*, N.F. 7, 294.

† See Barth, *Berliner Berichte*, iv. Jahrgang, S. 633; Ascher, *ibid*, iv. Jahrgang, S. 650; Fittig, *Zeitschrift fur Chemie*, N.F. 7, 181.

‡ *Ann. d. Chem. u. Pharm.*, cxlviii., p. 30.

§ *Ibid.*, cliii., p. 326.

the sulphobenzoic acid had been of influence on the product. Instead of waiting until the sulphuric anhydride had entirely dissolved the benzoic acid, as Barth did, I had added a small amount of fuming sulphuric acid to the semi-liquid mass after a time, and then heated gently until complete solution resulted. This shortened the operation somewhat, as the lumps of benzoic acid, which had become packed together, were thus brought under the direct influence of the fuming acid; whereas, before, they were covered with a thick pasty layer, which protected them.

In order to decide the question, I made two experiments. First, sulphobenzoic acid was prepared strictly according to the method of Barth, every letter of his directions being followed, and the acid thus prepared melted with potassium hydroxide. Second, sulphobenzoic acid was prepared by simply heating benzoic acid with fuming sulphuric acid, and the product melted with potassium hydroxide. Strange to say, these two experiments gave identical results, which differed from that already obtained. Para-oxybenzoic acid was indeed formed in both cases, but in much smaller quantity than in the first experiment. Instead of appearing in the first deposit of crystals, it was now not observed until the second or third, but then unmistakeably. It possessed all the characteristics of the acid—its crystalline form, fusing-point, water of crystallisation, &c.

After this, a large number of experiments were made with the object of discovering the conditions which are favourable to the production of para-oxybenzoic acid by means of this reaction; but, although this acid was in every case obtained as a secondary product in much smaller quantity than oxybenzoic acid, the greatest possible variations failed to bring about the first remarkable result. I was hence obliged to abandon the hope of clearing up this point, and to look upon the innumerable experiments as having increased, rather than decreased, the mystery. It is thus, at least, shown that the product, which had been looked upon as an individual substance, is in reality a mixture; and—inasmuch as the properties of oxybenzoic acid are such as to preclude the possibility of judging positively in regard to its purity from its appearance, and as its thorough separation from para-oxybenzoic acid by means of crystallisation, when the two are present in the mixture in anything like equal proportions, is an impossibility—I endeavoured to discover some other means which might be employed advantageously for the purpose of separation.

It seemed possible, from a study of the salts of the two acids, that the cadmium salt might be called in to aid successfully in this project; but experiment soon showed that, however well the cadmium salt of para-oxybenzoic acid might crystallise in a pure condition, it resisted all attempts when mixed with the oxybenzoate.

According to Barth, the basic barium salt of para-oxybenzoic acid is easily formed by the addition of an excess of barium hydroxide to a somewhat concentrated solution of the acid, and this salt, being insoluble, or nearly so, is precipitated under these circumstances, whereas no corresponding salt of oxybenzoic acid is formed. Taking advantage of this fact, the solution of the two acids was treated with barium hydroxide, and a precipitate was thus obtained. On decomposing this precipitate, a quantity of pure para-oxybenzoic acid was obtained; but, on examining that which still remained in solution, it was found to be a mixture, and this method of separation proved to be of no value. Since the publication of my first notice on this subject, Barth has repeated his former experiments, and confirms my statement that para-oxybenzoic acid is always formed in the preparation of oxybenzoic acid from crude potassium sulphobenzoate. He at the same time, however, remarks that pure oxybenzoic acid may be obtained by means of this reaction, it being merely necessary to re-crystallise the crude product a few times from water. It is very possible that a pure substance may be obtained in this way, but it is a difficult matter to prove positively that this is the case, especially as we know that there is a source of impurity which, as we have seen, may vary greatly in its influence upon the character of the product. It seems to me, then, that, whenever for test-experiments pure oxybenzoic acid is required, it would be advisable to become convinced of its purity by some other means, and I would suggest the preparation of pure acid barium sulphobenzoate as the first step. This salt can be readily obtained in beautiful perfectly-formed crystals, the appearance of which is a test of their purity, and from this *pure* oxybenzoic acid can be obtained.

II. *Para-sulphobenzoic Acid, a Constituent of Crude Sulphobenzoic Acid.*

The formation of para-oxybenzoic acid under the circumstances mentioned above, might be due to two causes—either meta-sulphobenzoic acid might yield it through the instrumentality of molecular re-arrangement under the influence of heat and fusing potassium hydroxide; or crude sulphobenzoic acid, prepared as above, might contain both the para- and meta-varieties, which would account for the complex character of the resulting oxy-acid.

To test the first possibility, a quantity of pure acid barium meta-sulphobenzoate was prepared, and then converted into the potassium salt. This was melted with potassium hydroxide, and the product carefully examined. Not a trace of para-oxybenzoic could be discovered in it. The experiment was repeated a number of times, but the result was invariable. The second possibility thus became more probable.

That portion of crude sulphobenzoic acid which had yielded the large proportion of para-oxybenzoic acid was now investigated, in order, if possible, to detect the presence of a second substance in it. It was neutralised with pure barium carbonate, and the excess of the latter and the precipitated sulphate then filtered off. The clear solution was separated into two equal portions, and from one of these the barium precipitated by pure sulphuric acid, care being taken to avoid the least excess of the latter. On now mixing the two clear solutions again, evaporating to the point of crystallisation, and allowing to cool, long, flat, acicular crystals made their appearance. These had no resemblance to the known acid barium salt of sulphobenzoic acid. They were re-crystallised from water, and were now obtained in exceedingly beautiful form; repeated re-crystallisations failed to change this form. This being established, the salt was analysed, with the following results:—

I. 0·525 grm. salt lost in weight constantly up to 200°; above this temperature no loss took place; the entire loss was 0·047 grm. This portion of the salt gave 0·206 grm. $BaSO_4$ = 0·12113 grm. Ba.

II. 0·5307 grm. salt lost 0·494 grm. at 200°, and gave 0·2078 grm. $BaSO_4$ = 0·12219 grm. Ba.

	Calculated.		Found.	
$(C_{14}H_{10}S_2O_{10})$ ..	402	67·79	—	—
Ba ..	137	23·10	23·07	23·02
$3HO_2$ ..	54	9·11	8·95	9·31
	593	100·00		

The formula thus deduced, viz., $(C_7H_5SO_5)_2Ba+3H_2O$, is, however, the same as that given for the known salt of sulphobenzoic acid; and hence, though the evidence might be strong in favour of considering the analysed crystals as representing a second and new variety of the salt, it was by no means conclusive. Two experiments were now made, the results of which were decisive. In the first place, the mother-liquor from the salt obtained was evaporated down, and then yielded a mixture of two well-characterised salts—the long flat crystals, and moderately well-formed, apparently monoclinic, prisms. On separating the latter as well as possible from the super-imposed crystals, and re-crystallising them, they were soon very much improved in appearance, being now perfect in form, and corresponding in every way to the known salt of sulphobenzoic acid. These, as well as the other crystals

mentioned, retained their form through a series of crystallisations. They were analysed for the purpose of comparison.

0·5182 grm. salt lost 0·0484 grm. at 200°, and gave 0·2038 grm. $BaSO_4$ = 0·1198 grm. Ba.

		Calculated.		Found.
$(C_{14}H_{10}S_2O_{10})$	..	402	67·79	—
Ba	..	137	23·10	23·12
$3H_2O$	..	54	9·11	9·34
		593	100·00	

Again, the acicular crystals were converted into the potassium salt, and this melted with potassium hydroxide. The reaction was very clean, yielding immediately a perfectly colourless well-crystallised product. This possessed all the characteristics of para-oxybenzoic acid, viz.—the same degree of solubility in water, the same fusing-point, the same crystalline form; they also contained water of crystallisation. With these facts an analysis was deemed unnecessary. The conclusion is therefore justified that the acicular crystals are the salt of a second variety of sulphobenzoic acid, which, adopting the ordinary nomenclature, would naturally be called *para-sulphobenzoic acid*.

The presence of this acid in the crude product from the action of sulphuric acid in benzoic acid accounts, then, satisfactorily for the unexpected formation of para-oxybenzoic acid under the circumstances mentioned above. The varying proportions of oxybenzoic and para-oxybenzoic acids, as final products of the series of reactions, corresponded to similar varying proportions of meta-sulphobenzoic and para-sulphobenzoic acids formed in the primary reaction. This simultaneous formation of the two sulpho-acids is in perfect harmony with known facts, it being the rule that, when substitution-products are formed by the direct action of substituting agents upon the mother-substance, at least two varieties of the product are formed, if this is possible. But why is it that in one case a larger (sometimes very large) quantity of the para-acid is formed, while in another only a small quantity is formed? I have in vain endeavoured to answer this question; and it was with a feeling of great dissatisfaction that I was obliged to abandon it, as the solution of this problem would have had a much greater interest than the discovery of the para-sulphobenzoic acid. It appeared probable that the case under consideration might correspond to that studied by Kekulé* in connection with the isomeric varieties of sulphophenolic acid. In this case, the meta-acid is formed almost exclusively when the reaction is allowed to take place at the ordinary temperature, but, when the temperature is elevated, the amount of the para-acid is increased gradually, until finally it is the only product. The meta-acid is then converted into the para-acid by the action of heat and sulphuric acid. Acting according to the suggestion thus offered, I attempted to convert meta-sulphobenzoic acid into the para-variety; but, as already stated, no amount of heating, no matter how long continued, brought about the desired result. Variations in the method of preparation were introduced as long as thought continued to suggest them—some of these were apparently trivial, some decided; but I only succeeded in accumulating a mass of negative information of no particular value.

According to the experiments made, para-sulphobenzoic acid is always produced when sulphuric acid acts upon benzoic acid. When it is present in the product in comparatively large quantity, it can be readily separated from the isomeric compound by means of the acid barium salt. If, however, it is present in small quantity, as is generally the case, it is very difficult, if not impossible, to obtain it in a pure condition. On preparing the acid barium salt, and evaporating the solution of the mixture, pure meta-salt is at first deposited; but, when the solution has attained a certain degree of concentration, the two salts crystallise out together, the long crystals generally appearing first, and the monoclinic crystals of the meta-salt being then deposited upon and among these in such a complicated manner that the task of separating the two mechanically is not in the least attractive nor promising. Repeated crystallisations do not change the character of the crystals.

I now endeavoured to find other means of separation, and among those tested was the partial crystallisation of the acid sodium salts of the two acids. No better success attended this experiment. All other experiments made in this direction gave the same result. I was thus prevented from gaining possession of any respectable quantity of the new acid in this way, and, as its study seemed to offer a prospect of interesting results, I turned my attention to attempts to find other methods for its preparation.

(To be continued).

* *Berliner Berichte*, ii. jahrgang, s. 330.

ON A

RELATION SUBSISTING BETWEEN THE ATOMIC WEIGHTS, SPECIFIC GRAVITIES, AND HARDNESS OF THE METALLIC ELEMENTS.

By S. BOTTONE.

By a careful consideration of the atomic theory, the writer was, in 1865, led to the conclusion that, if the ordinarily received notions respecting atomic heat, atoms, &c., were correct, a relation would undoubtedly exist between the relative specific gravity, atomic weight, and hardness of any given element. Many difficulties were encountered before any definite results were attained, owing principally to the difficulty of obtaining a definite scale of hardness, Mohr's scale being found to be utterly unreliable for this purpose, as a softer body was found to be able to scratch a harder one, provided a certain angle of the scratching surface were presented to the surface to be scratched. Other methods were therefore studied, in order to get an idea of the relative hardness of bodies; two of these will be described, the writer having found them to yield reliable and corresponding results.

1. A solid cylinder of highly tempered steel, of 1 centimetre in diameter, is fitted so as to run easily into a collar formed in the transverse bar of a rectangular metal frame. This steel cylinder, to which the name "plunger" has been applied, is so constructed at its upper extremity that measurable pressures can be at will applied, by means of a hydraulic press, or otherwise. The surface of the cylinder is graduated with millimetric divisions, so that the operator can read off easily the distance to which the cylinder, or "plunger," is made to descend. The bed of the frame is a thick plate of cast-iron. A small cake of the metal to be examined is placed on the iron bed directly under the plunger, this being raised to admit of its introduction. The operator now notes, by means of the scale on the plunger, the height at which it stands, and pressure is then applied until the plunger has descended, say, 1 centimetre. The pressure required to effect this is now noted,* and other cakes of different metals subjected to the same treatment, the pressures necessary to produce 1 centimetre of indentation being carefully noted in each case. These different pressures are in direct proportion to the hardness of the metal operated on.

2. This method, though perhaps not so exact as the preceding, is very useful in deciding the hardness of such metals as are brittle. It consists in mounting a soft iron disc on a lathe, and imparting to it a fixed invariable velocity. The metal to be tested is then applied to the edge of the disc, and pressed against it with a constant pressure. The *time* required to cut a certain depth will

* By means of a manometer.

be in proportion to the hardness of the metal examined, and this irrespective of its tenacity or brittleness.

Another point which rendered these experiments difficult was the almost absolute impossibility of obtaining some metals in a state of perfect purity, and the writer has noted with astonishment the extraordinary power which a mere trace of another metal has, in causing the hardness of a given metal to vary, sometimes increasing, and at others diminishing, this property to an unexpected extent. Great care has, however, been taken in the cases mentioned below; and, although other metals have been operated upon, the results are not given, as the metals were in a state of doubtful purity; hence the results might be misleading. Column 1 gives the sp. gr. of the metal (and this was actually verified in each case); column 2 gives the atomic weight; column 3 gives the relative hardness as deduced by calculation (by dividing the number denoting the sp. gr. by that denoting the atomic weight); and, lastly, column 4 gives the hardness as obtained by actual experiment, but reduced for facility of comparison to the same standard as column 3. It may not be out of place to remark that the temperature at which these experiments were made was 60° F.

Name of Body Examined.	Specific Gravity.	Atomic Weight.	Hardness* Calculated.	Hardness by Experiment.
Manganese ..	8·013	55·0	0·145690	0·145600
Cobalt	8·5	58·8	0·144559	0·145000
Nickel	8·279	58·8	0·140790	0·141000
Iron	7·7	56·0	0·137500	0·137500
Copper	8·66	63·4	0·136377	0·136000
Palladium ..	11·8	106·6	0·110694	0·120000
Platinum ..	21·5	197·4	0·108966	0·110655
Zinc	7·0	65·2	0·107692	0·107700
Indium	7·277	74·0	0·098337	0·098400
Gold	19·3	197·0	0·097969	0·097900
Silver	10·4	108·0	0·096296	0·099000
Aluminium ..	2·25	27·4	0·082116	0·082120
Cadmium ..	8·6	112·0	0·076785	0·076000
Magnesium ..	1·743	24·0	0·072625	0·072620
Tin	7·2	118·0	0·061881	0·065090
Thallium ..	11·862	204·2	0·057405	0·056500
Lead	11·38	207·0	0·054975	0·057000
Sodium	0·934	23·3	0·040085	0·040000
Calcium ..	1·578	40·0	0·039450	0·040500
Potassium ..	0·865	39·15	0·022094	0·023000
Diamond ..	3·5	12·0	0·291666	0·300960

A glance at these figures will show the reader how nearly the theoretic result approaches to that of actual trial. The writer believes that, by a comparison of the hardness and specific gravity, we have another method, besides that of atomic heat, for checking the atomic weight of such metals as are doubtful in this respect. For this reason he prefers the figure 74, as denoting the atomic weight of indium, to that of 75·63, as it is more consonant with the hardness and specific gravity of this metal.

It is with much diffidence that the writer lays these results of his experiments before the reader, as he is aware that his appliances are very rough; but he trusts that they have yielded results sufficiently conclusive and interesting to merit further research in this direction.—*English Mechanic.*

THE PHYSOMETER, A NEW INSTRUMENT FOR THE DETERMINATION OF VARYING VOLUMES OF GAS AND OTHER SUBSTANCES.†

FEW problems in nature have been more puzzling than the purpose served by the swimming-bladder in fish. Those who have sought to explain its action may be ranged according to two different standpoints—some have viewed it as an auxiliary organ of respiration; others as a hydrostatic apparatus, by which the fish can alter its specific gravity, and rise or sink in the water at will. The former view was first given expression to by Needham, in Amsterdam, in the year 1668, in a time when the limited state of anatomical and other science did not permit of its being fairly verified. The originator of the second view appears to have been a certain A. J., who contributed a paper to the Royal Society in 1675. In the following year appeared Borelli's work, "De Motu Animalium," in which it is stated that a fish whose swimming-bladder is damaged, so that the air has been allowed to escape from it, remains at the bottom; and the author infers that the swimming-bladder not only makes the fish specifically lighter, but that it effects the rising or sinking of the fish, according as it is expanded or compressed.

The purely mechanical explanation (confirmed, apparently, by the presence of muscles in the bladders of several fish) was soon afterwards generally accepted, and has found several advocates in more recent times.

In the beginning of the present century, a modification of this theory was rendered necessary by the researches of Biot, De la Roche, and others, who, having analysed the gases found in the bladders of fishes, found them to be the same as those in the atmosphere, but in different proportions; and, in the case of fishes taken from a considerable depth, it was found that the proportion of oxygen was very much greater than in the atmosphere (sometimes amounting to 90 per cent). This seemed to indicate that the oxygen in the bladder was separated out from the blood circulating in its walls.

More recently, in 1863, the important experiments made by M. Moreau have proved that the swimming-bladder is an organ in which the surplus of oxygen taken into the blood in breathing is for a time separated and stored up, afterwards to return into the blood when the fish finds itself in water containing too little oxygen. These researches gave a severe blow to the ultra-mechanical theory, and demonstrated that the swimming-bladder must be something more than a mere hydrostatic apparatus. Again, in 1866, two observers, Monoyer and Gouriet, came independently to the conclusion that the compression and expansion of the swimming-bladder were not to be regarded as the cause of the sinking and rising in water.

Much further investigation is still needed on the subject.

The changes in the swimming-bladder, and the air in it, under different conditions during life, must be accurately determined. The most important of these conditions are—

1. The pressure to which the whole body, and so the swimming-bladder, is subjected, from the column of water above.

2. The quantity of oxygen dissolved in the water.

While the difference of pressure, which is dependent on the depth, must increase or diminish the volume of air without active expansion or contraction of the bladder, the volume can also be increased through a secretion of oxygen, and diminished through absorption of this gas, provided, that is, an equal volume of carbonic acid does not take the place of the oxygen (which is, on several accounts, improbable).

The question then is—Is there, in addition to these two chief causes of volume-change of air in the bladder, *a third?* Has the fish the power to compress this air or to remove existent pressure at will? For the present this must remain unanswered.

The presence, in some fishes, of muscular apparatus which might so act, does not compel the inference that such action occurs during life, nor that all other fishes have the same power.

It would be possible to give a satisfactory answer to the question only if we succeeded in making visible the volume-changes in the swimming-bladder during life. Any compression through muscular contraction should then reveal itself. The air, *e.g.*, contained in the swimming-bladder, will expand or contract quite gradually and regularly if the height of the superincumbent column changes. The volume-change, also, which is the result of

* Equal to sp. gr. divided by atomic weight.

† Abstract of a paper in *Poggendorff's Annalen*, by P. Harting.

a secretion or an absorption of air in the bladder, can only be gradual. Muscular contractions, on the other hand, generally take place quickly, at command of the will. If, then, the volume of the swimming-bladder is altered quickly, suddenly, especially if this change takes place in circumstances in which any alterations in external pressure are prevented, such a change may reasonably be attributed to muscular action.

In the year 1675, an experiment bearing on this subject was suggested by Robert Boyle, as follows:—

"To take a bolthead with a wide neck, and, having filled it almost full with water, to put into it some live fish of convenient size—that is, the biggest that can be got in, as a roach, perch, or the like,—and then to draw out the neck of the bolthead as slender as you can, and to fill that almost with water; whereupon the fish, lying at a certain depth in the water of the glass, if upon his sinking you perceive the water at the slender top does subside, you may infer he contracts himself, and if, upon his rising, the water be also raised, you may conclude he dilates itself."

I do not know whether this suggestion of Boyle's was ever carried out. It would obviously be difficult; and, if a fish were put in such an apparatus, the rise and fall of water in the slender neck would only show, what is doubted by no one, that the air in the bladder contracts when the column of water above the fish becomes longer, and expands when it becomes shorter. It appeared to me, however, that the idea forming the basis of this experiment might be usefully employed in construction of an apparatus which would permit not only of perceiving, but of measuring, the contraction and expansion of the swimming-bladder, and, moreover, of bringing the fish at will to a determinate point, higher or lower, in a column of water, the whole apparatus remaining closed and otherwise unaltered.

This apparatus, which I have termed the physometer, is of the following construction:—

A (Fig. 1) is a large glass cylinder, 63 c.m. high and 20 c.m. internal diameter, with a capacity of about 20 litres. It rests on a wooden disc, B, supported on three legs. A disc of thick plate-glass, *c*, covers the mouth of the cylinder (a little lard or wax having previously been put on the surfaces of junction), and is pressed down by an iron ring, *d*, having leather or caoutchouc under it, which ring is fixed in connection with the foot-piece by means of rods and binding-screws, *e e e*.

The glass disc has four openings, as seen in Fig. 2. One of these, *h*, in the centre, receives the thin measuring-tube, which indicates, by the rise and fall of water in it, the expansion or contraction of the contents of the cylinder. It has behind it a millimetre scale, supported on a square piece of lead which rests on the glass.

On either side of the middle opening, there is another, *i i*, having a brass guide fixed in it, in which the cylindrical brass rods, *m* or *n* (Fig. 1), can be moved up or down. These rods are exactly alike, about 64 c.m. long and 3·6 m.m. diameter. It is obvious that, if the one rod penetrates into the water exactly as much as the other comes out of it, the surface of the water-column in *o* remains unchanged. The extent of the rods' motion is indicated by scales, *s s*, similar to that in the centre. The rods are connected at their upper ends by a copper wire, which passes over the pulley, *u*, supported on the frame, *x v w y*. Thus, if one rod is pressed down a certain distance, the other rises just as much.

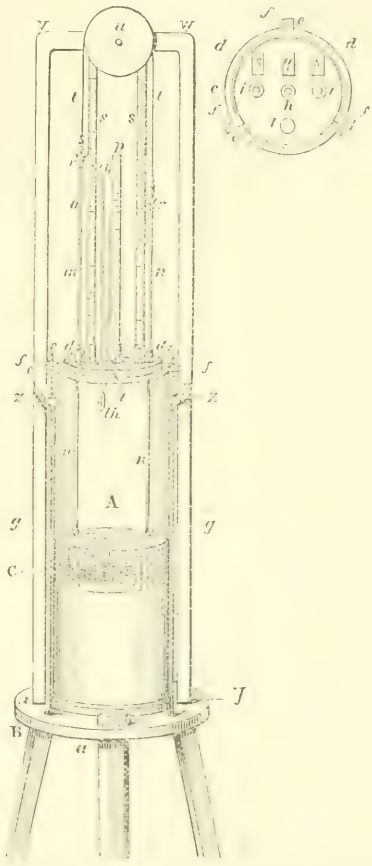
The fourth opening in the disc is in front of the central one, and serves for the introduction of water. It is closed by a caoutchouc stopper having two openings—one for a thermometer, the other for a short glass rod, which can be pushed up and down so as to bring the water-column in the measuring-tube, *o*, to a desired point, or to regulate its height.

To the lower extremity of either of the rods, *r r*, may be attached by a screw a sort of cage, C, of brass wire, and nearly as wide as the glass cylinder. This is for the fish, which is put in by a door on the upper side. The fish may either be allowed to swim freely in the cage, or be fixed to the sides. Other kinds of cage may be attached to the rods for experiments of a different kind.

It is important that there should be a perfect junction between glass disc and cylinder. The water employed should contain sufficient oxygen for a fish to be able to live in it some time. The apparatus should contain no free air.

When the instrument, containing cage, fish, &c., has been filled with water, and a measuring-tube has been

FIG. 1. FIG. 2.



fixed in the centre of the disc, the caoutchouc stopper, with thermometer, but at first without glass rod, is put in the opening, *l*; any surplus water then flows out through the hole in the stopper. The glass rod being then introduced, the water-column in the measuring-tube can be raised to any desired height. The two movable rods, *m* and *n*, are connected by the wire, the scales are put in position, and the apparatus is ready for use.

A. B. M.

(To be continued).

CORRESPONDENCE.

LIEBIG'S EXTRACT OF MEAT.

To the Editor of the Chemical News.

SIR,—May I ask you kindly to mention that the lamented death of Baron Liebig will in no way affect the manufacture of the Liebig Company's extract of meat?

The control and analysis exercised hitherto by Baron Liebig and his delegate, Professor Max von Pettenkofer,

will in future be carried out, with the same knowledge, care, and attention, by Professor Max von Pettenkofer and Hermann von Liebig, son of Baron Liebig, he having acted so far as special assistant to his father in the control and analysis of Liebig Company's extract.

The well-known standard quality of the Liebig Company's extract of meat will thus continue absolutely unaltered.—I am, &c.,

CHAS. R. OTTER, Secretary.

Liebig's Extract of Meat Company, Limited,
London, April 26, 1873.

NEW INSULATOR.

To the Editor of the Chemical News.

SIR,—Some time ago I discovered, in the course of experiments, that vegetable tar, by the addition of the oxides of lead (or in a less degree by some other substances), is almost instantly solidified, and that the solid substance thus obtained has remarkable insulating powers.

In some experiments at Silvertown, I found that No. 18 copper wire, covered with a coating of gutta-percha weighing only 21 lbs. to the mile, had its insulation increased nearly 200,000 per cent, and that the insulation resistance was no less than 2,800,000,000 units, an insulation sufficient for any lengths possible on the surface of the earth.

Insulation of so great cheapness makes all further experiments on telegraphy without insulation needless, though in fresh water or by land this can be effected to very great distances.—I am, &c.,

H. HIGHTON.

Putney, April 30.

MANUFACTURE OF SULPHURIC ACID.

To the Editor of the Chemical News.

SIR,—Two letters in your last issue call for a short reply on my part.

Mr. McCulloch's letter does not in the least invalidate what I contended, viz., that that gentleman stands quite isolated among Tyne-side practical men in his advocacy of "steam columns" against "Glover's towers" for denitrating the nitrous acid in the sulphuric acid process. He still does not say that he has had any practical experience in *working* with Glover's towers, and the fact that he has prepared the plans and partially superintended the erections for these towers in the last important Tyneside factory which had hesitated to adopt them, does not prove very much against them. Your readers will judge for themselves whether Mr. McCulloch has made out any case against the exceptions taken by Mr. Glover and myself to his paper in your columns.

Mr. McCulloch further says that the rule of three gives erroneous results in the case referred to (the estimation of nitrous acid absorbed by sulphuric acid) and is therefore no guide at all. To this I must entirely demur; the practical acid-maker does not require an analytical method indicating the *absolute* quantity of nitrous acid, but it suffices for him to have a method allowing him to *compare* one sample of acid with another, in order to serve him as a safe guide in managing the chambers. In my laboratory the permanganate method is used, which takes only a few minutes for each test, and amply repays the small trouble.

It is hardly worth while disputing about the extra quantity of nitre required in starting a set of chambers, a contingency of such rare repetition; but I think Mr. McCulloch would have some difficulty to *prove* his assertion that a very serious (if any) extra quantity is required with Glover tower against steam columns.

Touching Mr. Peter Hart's letter, I have only to say that I have no connection whatever with Mr. Helbig's alleged improvement in the manufacture of caustic soda, except that of an abstractor of his paper published in *Dingler's Polytechnisches Journal.* Mr. Hart has, no doubt, proved that there is nothing whatever new in Helbig's process, and the only merit of the latter seems to be to have brought about this discussion, and elicited the testimony of such an experienced chemist as Mr. Hart in favour of what properly should be called "Ralston's process."—I am, &c.,

GEORGE LUNGE.

South Shields, April 26, 1873.

THE SODA PROCESS, AND PROPOSED IMPROVEMENTS.

To the Editor of the Chemical News.

SIR,—I have seen Mr. Hargreaves's letter of the 8th inst. (CHEMICAL NEWS, vol. xxvii., p. 183) to-day for the first time, and I regret that anything that I said in my paper should have appeared to disparage the process with which his name is connected. My paper was read last year, and I stated the prevalent notion then, that the process could not be worked to obtain a good sulphate without suffering a large quantity of sulphurous acid to escape. It is, however, gratifying to learn that Mr. Hargreaves has surmounted this difficulty, and, if his other statements, regarding fuel and repairs, stand the test of continued working on the large scale, the process cannot fail to be soon very generally adopted.—I am, &c.,

DAVID HILL.

St. Bede Chemical Works, South Shields,
April 26, 1873.

MISCELLANEOUS.

Stalactitic Gelatinous Silica.—In experimenting at the Central High School with silicate of soda solution, it was found that when such solution is placed in a small porcelain capsule or other suitable vessel, and to it is added about an equal volume of concentrated sulphuric acid, taking care not to add to it too suddenly, the silica deposited prevents the thorough mixing of the acid and silicate. If now the vessel be inclined so as to allow the liquids to run as a stream from the vessel, the deposition of the silica takes place in the form of an icicle or stalactite depending from the lip of the capsule. On close examination, it is found that the acid runs upon the outside of the stalactite, whilst the silicate flows down the centre, or *vice versa*, the mass growing by successive additions to the lower extremity. The experiment is at once both pleasing and instructive.—*Elihu Thompson in the Journal of the Franklin Institute.*

Soluble Glass as a Detergent.—MM. Baerle and Co., of Worms, have published the following on the employment of soluble glass as a detergent:—The employment of soluble glass in the washing of wool is an important fact in this industry. The treatment is so simple and so economic that it is only necessary to make an experiment to recognise its advantages. Take 40 parts of water, at the temperature of 50° to 57° C., and 1 part of soluble glass; plunge the wool into the mixture, stirring it about for a few minutes by the hand, then rinse it in cold or tepid water, and it will be found completely white and void of smell. The wool after this operation remains perfectly soft, and loses none of its qualities, even when left for several days in the solution of the silicate, and being washed in hot water. Sheep may also be washed with the same preparation, care being taken to cover the eyes of the animals with a bandage, to perform the washing with the solution instantaneously, and to remove the surplus with tepid water. In the case of combed wool, the wool should be first steeped in the solution above given, and afterwards in another bath composed of 80 parts of water at 37° C., and 1 part of soluble glass. In this way the effect is excellent and economic, without the employment

of soap or soda, and the wool is rendered at least equally white, clean, and soft as by other methods. Soluble glass may also be employed advantageously for domestic washing. A bath must be prepared over night, with 20 to 30 parts of water at 50° to 57° C., and of 1 part of neutral soluble glass; the linen is plunged into this bath and left there till the following morning, when, after the bath has been re-heated with additional hot water, it is to be worked with a wooden stamper. The aspect of the solution tells when the linen is nearly cleaned, when the former is to be drawn off and the linen drained. The operation is then completed by rinsing with a little soap; but it is well to pass the linen again through a weak solution, consisting of 1 part of soluble glass to 50 parts of water at 45° to 50° C., and then to rinse it out in pure water.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, April 14th, 1873.

Theory of the Sun Spots.—P. Secchi.—This is a reply to M. Faye's last note correcting certain misrepresentations. In an appended note the writer states that, having examined the drawings of sun-spots and protuberances in 1871 and 1872, he finds that of 300 spot groups in the former year 209 were accompanied with eruptions (or two-thirds); of 292 in the latter 150 (or about a half): a proportion which he thinks significant for his theory.

Reply to P. Secchi and to M. Vicaire.—M. Faye.—The writer vindicates his former assertion that the eruption hypothesis involves a number of gratuitous assumptions.

Report on a Memoir of M. Boussinesq Entitled "Essay on the Theory of Water Currents."—The committee give a somewhat lengthy analysis of this important work; in which M. Boussinesq treats of the motion of water in pipes and in open channels—considering fluid sections of various forms, especially those which are rectangular and of considerable breadth, constant, or gradually variable, and the circular or semicircular. Also cases in which the bottom of the channel presents longitudinally a sensible curvature—non-permanent movements, such as those in rivers at times of flood—the laws which regulate the propagation of waves at the surface of flowing water, with the influence of slopes, friction, curves, &c. The committee remark on the agreement between the author's theoretical results and those of actual experience, and regard the treatise as one of much practical value.

New Observations on the Theory of Solar Cyclones.—M. Vicaire.

Note on the Effects Produced by Currents on Mercury Immersed in Different Solutions.—Th. du Moncel.—When the current from a battery of 8 Chutaux elements is passed through spring-water for an electrolyte—the electrode being a large drop of mercury connected with the negative pole, and a platinum wire with the positive—the polarisation current, on closing the secondary circuit after five minutes action of the battery, and through a circuit of 12 kilometres of telegraph wire, has at first an intensity represented by 7 or 8 degrees on a zinc galvanometer with two spirals of wire. This current gradually disappears in three minutes. With acidulated water the effects were less. With a saturated solution of chloride of sodium (other conditions the same) the polarisation current had at first an intensity of 25°, disappearing in fifteen minutes. With potash solution (salt in proportion of a fourth of weight of water) primary strength 26°; disappeared in fourteen minutes. With 3 per cent solution of cyanide of potassium, 18° 45'; twelve minutes. With solution of chlorhydrate of ammonia, 45° to 50°; five minutes. Thus we may form with these solutions gas couples and batteries of polarisation more energetic than those which have for base oxygen and hydrogen.

On Irradiation.—M. F. P. Le Roux.—The writer says he can at will neutralise irradiation. Thus, he can see the circumference of the luminous part of the moon continuous with that of the dark part; or see a flame no longer encroach on a screen placed beside it; the angles of white squares on a chess board no longer joined by a white ligament (indeed, the appearance may be reversed, and dark squares be seen joined by a dark ligament). He points out that for the field of distinct vision, about the *fovea centralis*, there is no irradiation. From this spot outwards the distinctness of perception rapidly decreases, and we naturally tend to equilibrate the sensations at the periphery of the object. If one of the horns of the lunar crescent is brought into the field of the *fovea centralis*, the irradiation there disappears; but by a peculiar compensation that at the other horn appears more than doubled. M. Le Roux further discusses the case of observation with the naked eye (as well as with telescopes when observing transits of Venus) of a dark ligament between two opaque bodies on an illuminated ground, and says that by sustained attention he can make these disappear. The ligament is not a phenomenon of irradiation, but of imperfect accommodation.

Mutual Determination of the Constant of Attraction, and of the Mean Density of the Earth.—A. Cornu and J. Baille.—(See page 211.)

Les Mondes, April 10, 1873.

New Variety of Hexylene.—M. Tchäikowsky.—Among the hexylenes of different origin one is known—that of Buff—which furnishes a primary hexylic chloride on combining with hydrochloric acid. Another—that of Erlenmeyer and Wanklyn—is converted into a secondary hexylic iodide on uniting it to hydriodic acid. It became interesting to attempt the preparation of an isomeric hexylene having the property of transforming itself into a tertiary hexylic iodide on the addition of hydriodic acid. Tchäikowsky has attained this object, setting out from methyl-diethyl-carbinol. This alcohol was obtained by the method of Boutlerow, by causing chloride of acetyl to react upon zinc-ethyl. The alcohol has been converted into the corresponding iodide by the action of gaseous hydriodic acid. On treating this iodide with an alcoholic solution of potash in sealed tubes, first in the cold and afterwards at 100°, he obtained a liquid hydrocarbon, colourless, lighter than water, having a strong odour, and boiling between 68° and 72°. On analysis it gave 85·06 carbon and 14·57 hydrogen. On combination with hydriodic acid this hydrocarbon yielded a tertiary iodide, that of methyl-diethyl-carbinol, and was convertible into the latter by treatment with moist oxide of silver.

On Ethyl-Trimethyl-Formene.—W. Goriainow.—This new hydrocarbon, an isomeric variety of hexane, has been obtained by the process which Lwow used for the preparation of tetramethyl-formene. Each drop of zinc-ethyl added to the tertiary iodide of butyl produces a strong reaction and rise of temperature. The fumes were passed first into hydrochloric acid, and then into alcohol well cooled. On adding water to the alcoholic solution and distilling, the hydrocarbon is collected as a colourless liquid. After treatment with bromine, and removal of the excess of the bromine by means of alcohol, the hydrocarbon is rectified, and treated for some time in the water-bath with metallic sodium. The greatest part of the purified hydrocarbon passes over at 43° to 48°. It contains 83·65 per cent of carbon, and 16·84 per cent of hydrogen. Its formula is assumed to be—

$$C_6H_{14} \left\{ \begin{matrix} C_3H_5 \\ (C\ H_3)_3 \end{matrix} \right.$$

Formation of Tertiary Chloride of Butyl by Means of Isobutylen.—D. Salewsky.—Isobutylen was condensed in tubes containing concentrated hydrochloric acid, and well cooled. The tubes were then sealed and heated for some hours in the water-bath. On opening the tubes there was no escape of gas or vapour; all the isobutylen was combined, with formation of tertiary butylic chloride, almost pure.

Transformation of Amylene into Amylic Alcohol by Means of Sulphuric Acid.—M. Flavitzky.—A mixture of 2 parts of concentrated sulphuric acid, and 1 part of water was employed. The amylene was caused to act upon it in the state of vapour.

Action of Bromised Bromide of Acetyl on Zinc-Methyl.—D. Idanow.—The results obtained are indecisive.

Trimethyl-Acetic Acid, a New Isomer of Valeric Acid.—A. Boutlerow.—The acid is volatile without decomposition at 160·5° to 161·5°. The distillate is colourless, and solidifies immediately. The composition is $C_5H_{10}O_2$. It is insoluble in water. Its odour recalls that of acetic acid and valeric acid, but is less offensive than the latter.

Le Moniteur Scientifique Quesneville, April, 1873.

New Method of Oxidation, and New Explosive.—MM. Houzeau and Renard.—Hitherto chemists have only employed complicated reagents to disengage oxygen at higher or lower temperatures, such as mixtures of concentrated sulphuric acid with peroxide of manganese and bichromate of potassa, or bodies rich in oxygen like the chromic and nitric acid. These oxidising agents are open to the grave defect of determining either secondary reactions due more frequently to the influence of the acids or bases employed than to the oxygen liberated; or of producing too violent action which, raising the temperature, renders it impossible to trace the formation of the primary products. Houzeau has conceived the idea of employing concentrated ozone as an oxidising agent. He had previously shown the method of obtaining ozone in a concentrated state, by means of a simple tube supplied within and without with a metallic armature. As the decolourising power of ozone in relation to indigo is 40 times greater than that of chlorine, Houzeau was led to apply it to the formation of new organic compounds. One of the most remarkable results is ozobenzine, formed at ordinary temperatures by the action of concentrated ozone upon benzol. Ozo-benzine is a white, amorphous solid, which is immediately decomposed with violence when its temperature is sensibly raised. Its explosive force is so great that if a few decigrms. are submitted to a slight shock the windows of the room where the experiment is performed are shivered to fragments. Olefiant gas

detonates immediately with violence if brought in contact with concentrated ozone. If we take in connection with these facts the former observations of the same author on the presence of ozone in the air, and on the natural circumstances which seem to concentrate it occasionally in certain points of the atmosphere, we are entitled to ask whether, in some cases, conflagrations and explosions may not be due to this powerful chemical action, without any negligence or criminal intention on the part of persons concerned?

La Revue Scientifique de la France et de l'Etranger, April 19, 1873.

This number contains no original papers on chemistry or its allied sciences.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS

Delivered from October 5 to October 11, 1872.

A new or improved process for the manufacture of soap. William Lorberg, North Bow, Middlesex. October 8, 1872.—No. 2959. The features of novelty of this invention consist in a new or improved process of manufacturing soap. I take a definite quantity of fat, animal or vegetable, or a mixture of the two, or a mixture of either of the two and rosin in the state of thick oil in proportions varying according to the quality of soap it is intended to produce, the finer varieties of fat yielding a soap superior to that formed by lower descriptions of fatty matters. The fats to which I particularly refer are tallow, mutton suet, or a mixture of the two known in the trade as "melted stuff." Animal oils, such as fish oils, cocoa-nut oil, palm oil, palm-kernel oil, cotton-seed oil, olive oil, and the like. The said mixture is heated to the melting-point, say about 100° F., the object being to have the fats in a liquid state at as low a temperature as possible, merely to insure contact with the chemical ingredients, afterwards to be mixed with them. To this mixture I then add gradually and with diligent stirring from 50 to 60 per cent of a solution of caustic soda, indicating in the cold from 30° to 40° Baumé. As soon as combination has taken place, which it does with evolution of heat in a few minutes, I add water, solution of glutin, silicate of soda, or silicate of soda and potash, and for certain kinds of soap sulphate of soda, alumina, and carbonate of potash. The proportions of all these matters vary with the proposed quality of the soap, but in general they are as follows, namely, fat 100 parts, alkali 50 to 60 parts, silicate of soda or of soda and potash 25 to 50 parts, glutin 25 to 50 parts, water 20 to 50 parts. All the ingredients are added to the above compound in the cold, and thoroughly incorporated by stirring. The mass, which is now of a creamy subsistence, is covered up, allowed to heat and cool down again, which requires from twenty-four to forty-eight hours more or less, after which it is ready to be taken out of the frames and cut into slabs or bars, as may be desired. The soap then only requires to be seasoned, that is to say, to be exposed for some time to the influence of the atmosphere in a drying-room or other convenient shelter, which hardens and dries it.

Improvements in the manufacture of artificial manures. Benjamin Tanner, Liverpool, Lancaster. October 9, 1872.—No. 2974. This invention consists in the economical production of single, double, and triple superphosphates having one, two, or three alkaline bases instead of the lime, or in addition thereto, and the production of ammoniacal matters in combination or admixture therewith in a more or less rapidly soluble condition, so as to produce highly concentrated artificial manures. For the convenience of description the following paragraphs, which describe the processes embraced by this invention, are numbered consecutively:—

1. Solutions of any form of phosphate of lime and other mineral phosphates are made in hydrochloric acid, phosphoric acid, water, or mixtures thereof, by well-known arrangements. These solutions are treated with silicic acid, or sulphuric acid, or oxalic acid, or mixtures thereof, to remove any portion of the lime present, and, by preference, to reduce it in relation to the phosphoric acid to the proportion present in mono-calcic, bi-calcic, or tri-calcic phosphate. Sulphate, silicate, or oxalate of potash or mixture thereof, is or are then added to the liquor, for the purpose of removing all or a portion of the lime, and for substituting potash. The liquor is separated from any insoluble salts formed, and the clear liquor, on evaporation, yields a superphosphate of potash more or less intermixed with superphosphate of lime, and in such proportions as may be desired. Any other corresponding alkaline salt or salts may be used instead of, or in conjunction with, the potash added thereto, and any form of single, double, or triple superphosphate can thus be produced.

2. A very similar result is attained by adding the base or bases to be substituted for the lime or alkaline matter in a caustic condition, or in combination with any acid or elements which during the process of manufacture are decomposed or volatilised, such as chlorides, for example.

3. Phosphoric acid, or phosphoric and hydrochloric acids, more or less diluted with water, are also treated with the base or bases in a caustic condition, or in combination with any acids or elements (such as chlorides), which during the process are decomposed or volatilised, and their solutions, when evaporated, produce any form of single, double, or triple superphosphate. The superphosphates produced by the processes above described are sometimes further concentrated by dissolving the soluble portion in water, separating the insoluble matter, and evaporating the liquor as hereinafter described. If desired an additional quantity of alkaline matter is added.

4. These solutions, when prepared for evaporation, are intermixed with shoddy, woollen waste, blood, flesh, or other form or forms of nitrogenised matter, and evaporated to dryness, a single, double, or triple superphosphate being obtained, having ammoniacal matter in a slowly soluble form intermixed therewith.

5. The solutions described in paragraph No. 1 are also treated in the manner therein described, or solutions of phosphoric acid are intermixed with shoddy, woollen waste, blood, flesh, or other form or forms of nitrogenised matter, and evaporated to dryness. The product I call "ammonio-phosphate."

6. Phosphoric acid or solutions of phosphate of lime and other phosphates in hydrochloric acid, phosphoric acid, water, or mixtures thereof, is or are intermixed with ammonia, and with sulphate or bi-sulphate of lime. The proportions of the materials shall be, for every equivalent of phosphoric acid present there shall be present one, two, or three equivalents of lime, or any intermediate quantity; and for every equivalent of sulphuric acid there shall be one equivalent of ammonia present. The insoluble matter may be separated, and the clear liquor evaporated. The product will be a superphosphate of lime having ammonia in a rapidly soluble form intermixed therewith.

7. When it is desired to separate any portion of the ammoniacal salt formed as described in paragraph No. 6, the liquor which has been prepared for evaporation is concentrated sufficiently to enable the ammoniacal salt to crystallise out, the remaining liquor is evaporated to dryness, yielding a product similar to that described in paragraph No. 6, but less rich in ammonia.

8. The several forms of superphosphate herein described may be phosphated and rendered more powerful as a manure by the addition of phosphoric acid thereto.

9. It is preferred to carry out the evaporation by the use of steam, or hot air, or mixtures thereof, the action being safer and more satisfactory.

Improvements in the manufacture of alkalies, and in apparatus employed therein. James Hargreaves, chemist, and Thomas Robinson, ironfounder, Widnes, Lancaster. October 10, 1872.—No. 2982. Our said improvements consist, first, in intimately mixing sulphate of soda and sulphate of potash, or either of them, with coal or other carbonaceous material and metallic oxides, and fusing them in a crucible heated from the outside, the said crucible having an outlet at the bottom to allow the fused crude soda or potash to flow out when finished. Second, in using iron, preferably cast-iron, to form the crucibles aforesaid, or to form the beds and sides of furnaces used in the manufacture of crude soda or potash.

Improvements in evaporating liquids, and in the means or apparatus to be employed therein. Albert Ungerer, chemist, Simmering, near Vienna, Austria. October 10, 1872.—No. 2985. This invention, which relates to improvements in evaporating liquids, consists of a perpendicular shaft or tower constructed of stone or other suitable material, and covered with a perforated platform or cistern, from which a considerable number of wire or other ropes or rods are suspended into the interior of the tower. The liquid to be evaporated is first conducted to the top of the tower, and then allowed to run down through the perforations in the cover along the ropes or rods at a speed which can be regulated according to circumstances. Hot air or the products of combustion proceeding from a furnace enter the tower near its base, and escape through an opening near its top, meeting on their way the liquid spread over the immense surface afforded by the ropes, and thus concentrating the same by evaporation, more or less according to the heat of the gases and the speed at which the liquid is allowed to run down the ropes. It is preferred to place a cistern at the base of the tower, in order to collect the concentrated liquid and so that it may be removed.

NOTES AND QUERIES.

Action of Heat on Gems.—The effect of the oxy-hydrogen flame upon beryls and emeralds has been fully studied by Mr. Greville Williams, whose results will be published very shortly.

Oxychloride of Lead.—Can any of your readers inform me if it is possible to make oxychloride of lead perfectly white, and how?—C.

Removing Smell from Dissolved Gutta-Percha.—Would any of your readers kindly inform me of a method of removing the disagreeable smell left in gutta-percha and other substances when bi-sulphide of carbon has been used as a solvent? Long exposure of the substance, even in thin films, to the air does not answer the purpose.—M.

MEETINGS FOR THE WEEK.

Monday, 5th.—Royal Institution, 2. (General Monthly Meetings).
—— Medical, 8.
—— London Institution, 4.
Tuesday, 6th.—Royal Institution, 3. Mr. Dannreuther, "On the Music of the Drama."
—— Civil Engineers, 8.
—— Anthropological, 8.
—— Zoological, 8.30.
Wednesday, 7th.—Society of Arts, 8.
—— Microscopical, 8.
Thursday, 8th.—Royal Institution, 3. Prof. Tyndall, "On Light."
—— Royal, 8.30.
—— Royal Society Club, 6.
Friday, 9th.—Royal Institution, 9. Mr. Grant Duff, M.P., "A Fortnight in Asia Minor."
—— Astronomical, 8.
—— Quekett Microscopical Club, 8.
Saturday, 10th.—Royal Institution, 3. Prof. Odling "On Ozone."

SUPPLEMENT
TO
THE CHEMICAL NEWS.
Vol. XXVII. No. 701.

ON THE

ALKALINITY OR ACIDITY OF CERTAIN SALTS AND MINERALS, AS INDICATED BY THEIR REACTION WITH TEST-PAPER.*

By W. SKEY, Analyst to the Geological Survey of New Zealand.

A knowledge of the reaction of various substances with test-paper is justly esteemed of considerable importance, since it enables us at once to refer them to one or other of three distinctive groups, each of which has strict regard to the molecular structure of those substances falling within it, as manifested by the chemical combinations they are most prone to form. These groups are, as is well known, the alkaline or basic, the acidic, and the neutral, and properly prepared test-paper indicates the one to which any particular substance belongs, by suffering certain colourations when brought in contact with it, these changes being the result of chemical ones, by which the combinations previously existing among the colouring matter of such paper are ruptured, and new ones superinduced.

The terms alkalinity and acidity, therefore, have a signification expressive of condition, and their real meaning is only this, that, as applied to any substance, they indicate a tendency in such to form combinations with acid or alkaline bodies, as the case may be. Neutrality, however, has a relation more to the breaking-point (if I may so term it) of these combinations in the litmus-paper, than to absolute condition of the substance tested; for it is easy to conceive that a substance may be acid or alkaline, and still, by reason of the feebleness of either of these characters, be unable to overturn the combinations referred to, and so manifest either of these reactions.

I only point this out that I may not be misunderstood in the use I make of the term neutrality, and not for the sake of opening a question, as I do not attempt here to remove the neutral point thus arbitrarily located to a position nearer to the true one, preferring to take up ground less subject to criticism, and of more immediate interest, viz., that set forth in the heading of this paper, to which, after the above necessary explanations, I now address myself.

These reactions being in general so easy to obtain in the case of bodies capable of manifesting them, I may perhaps be deemed hypercritical when, in the course of this statement, it is found that my remarks tend to show that the condition of certain of these bodies, as demonstrated by such tests, has been misstated in our popular works on chemistry, and that this has tended inferentially to involve us in further errors relative to the numerous substances chemically allied thereto; at the risk of being thought so, however, I do not hesitate to make the following remarks, and the exact condition of such bodies shall be the principal subject of this paper.

The ores I particularly object to as having their true characters in these respects misstated, or inferentially liable to be misapprehended, belong to a class of salts insoluble, or nearly so, in water. They are the carbonates, borates, silicates, phosphates, and arseniates of the alkaline earths (lime, baryta, strontia), also of magnesia, silver, and lead. Theoretically, they should be *alkaline*, from the following considerations.

Taking an equivalent of any of these bases, and combining it with one of sulphuric or any of the stronger acids, we have a salt corresponding to those of the alkaline mono-sulphates in being *neutral*. Thus, under these conditions, the bases referred to are, equivalent for equivalent, equal in degree of alkalinity to that of the alkalies (potash, soda, &c.), and, therefore, the corresponding salts of these two classes throughout should possess one common character in respect to this particular reaction.

Now the alkaline carbonates, borates, and their common phosphates, &c., give a very decided alkaline reaction with litmus-paper properly prepared; they are indisputably *alkaline*, but the corresponding salts of lime, strontia, &c., are, as a rule, accepted either from experimental results direct, or from inferences based on them, as being neutral, although, from the above considerations, they ought to be alkaline.

The importance of ascertaining which of these two assumptions is correct is obvious, for, if these salts are in reality neutral, we learn, and must take cognisance of, a radical difference existing either in the acids or the bases of which these salts are made up, according as the other portion of the salt is possessed of powerful or weak affinities. In such a case lime, for instance, would not retain the same degree of saturating power (quantivalence) through all its combinations with the acids, the degree of this in any case being determined by the strength of the acid employed; a strong one being thus necessary, as it were, to draw out its highest capabilities in this respect.

Our recently acquired knowledge of the mobility (if I may term it so) of the component molecules of bodies in respect to each other, even in the case of simple elements, and the great tendency many of them manifest to form *intercombinations* among themselves, dispose us favourably towards a belief which, by ascribing a variable potentiality of this nature to these bodies, explains away the apparent anomaly I have just referred to as pertaining to them in their present reputed condition, and make it very desirable to have experimental results, by which to enable us to decide between theory and our present belief. Results, therefore, having for their sole purpose this object I now relate, from which it will be seen, I think, that theory is in this case our safer guide.

The ground taken up by these results has been already just broken in upon, as will perhaps be remembered, in a communication to this Society, entitled "The Alkalinity of Carbonate of Lime," and while the criticism which it evoked has been already useful in stimulating me to this inquiry, it will be useful again, but in a different manner, by supplying us with a knowledge of the precise conditions deemed necessary, by a well-known chemist, to insure reliable indications when testing substances generally in respect to their behaviour with the test I am employing—litmus-paper. Using the precautions recommended in this criticism, I prepared the test (litmus-paper) for use by simply washing it in water free from ammonia till it acquired a pale violet colour, in which condition "it is a delicate test for either acids or alkalies."

Thus prepared, the test, when pressed upon them in a moist state, indicated the conditions of the following substances to be as stated below:—

Alkaline.	Acidic.	Neutral.
Carbonate of magnesia (magnesite).	Phosphate of alumina (wavellite).	Quartz.
Carbonate of lime (calcareous spar).	Phosphate of zinc crystallised.	Clay (purest washed)
Carbonate of strontia.	Phosphate of iron (proto- and sesqui-).	Clay slate.
,, baryta.	Arsenite of zinc.	
,, lead.		
,, silver.		
Borate of magnesia (datholite) crystallised.		
Tribasic phosphate of lime crystallised.		
Tribasic phosphate of magnesia.		
Apatite.		
Phosphate of silver.		
Silicate of magnesia (olivine).		
Silicate of magnesia (serpentine).		
Mica.		
Felspar.		

* Read before the Wellington Philosophical Society.

If the terms acidity and alkalinity have any meaning, or if the test here applied to discover these properties is trustworthy, we cannot refrain from classifying those substances specified in the first and second columns of the foregoing table as alkaline and acidic respectively.

That the test used is trustworthy, in the case of alkalinity at least, and these results consequently so far correct, is in the highest degree probable, from the fact that it has been approved of, and I may say recommended, for this latter object, by one who attempts to demonstrate the condition of neutrality in a case for which, as aforesaid, I have assigned alkalinity.

The correctness of this table being allowed, we may safely and largely add to it by filling in with those salts analogous in chemical composition to the ones stated, or we may at once deduce from it the following general conclusions :—

(1). That those salts of the earthy oxides, as also those of the oxides of silver and lead, which contain single equivalents of carbonic, phosphoric, arsenic, or boracic acids, are alkaline.

(2). That the common silicates of these oxides are also alkaline.

(3). That the salts of the sesquioxides and the remaining metallic protoxides are acid when containing one equivalent or more of phosphoric or arsenic acid.

(4). That the silicates of the sesquioxides are neutral.

The salts of the oxides, therefore, enumerated under the foregoing Nos. 1 and 2 appear to agree, in respect to the characters under investigation, with the corresponding salts of the alkalies; the oxides themselves, as compared to those of the so-called alkalies, thus exhibiting an equal alkalinity through all their combinations, and therefore each oxide is, as far as we can judge, similar in molecular arrangement throughout all such combinations.

In the case of those salts comprised in section 3, it is seen that they compare with the sulphates and chlorides of the same or corresponding bases in being *acid;* but the degree of this acidity is, we know, dissimilar, and may be inferred from the character of alkaline salts with these acids respectively, which has been already described.

The facts above stated have a great significance in respect to the relative potency of the alkalies as compared with that of the alkaline earths; thus, the perfect equality of the bases magnesia and lime as compared with potash (equivalent for equivalent) in respect to alkalinity (here shown) will, if fully recognised, oblige us to dispute the title which this base now holds—that of being the most powerful of any we are yet conversant with.

In reality, lithia has far better claims upon this position, as having the lowest combining number, and being, equivalent for equivalent, undoubtedly equal to potash in basicity, it has, therefore, for similar weights, the greatest saturating power for acids.

Next to lithia is magnesia, then lime, soda, and *afterwards* potash. In this connection it is proper to remark that lithia is the only base which readily attacks platinum when fused upon it—a pretty good test of strength, one would think, and proving, as far as a single result has weight, that the relative position I here assign to this base is correct.

Both potash and soda, however, have certainly an appearance of being far more powerfully alkaline than any of the bases just compared with them; but this is due simply to the fact that they dissolve in water to a larger extent, and with far greater speed than these bases, whereby they are enabled to act with greater facility, and effect more, in a given time.

The fact is that, in our use of the term alkalinity, hitherto we have not expressed absolute potentiality, but rather energy or speed of action, and this speed being dependent (other circumstances being equal) upon the degree of solubility in water of the substance tested, we have thus unconsciously perverted the true meaning of the term (alkalinity), by making it denote a certain degree of solubility—a quality which we do not know is the least related to it.

It only remains to notice that, in relation to rocks, the terms basicity and acidity have, by the facts above stated, their significance enlarged, and their appropriateness rendered still more apparent than before, while the term neutrality is now shown to be predicable of certain of them, and to be equally significant.

The character of rock masses, or portions of them, in these respects may be discovered in a very direct and simple manner, by just pounding a portion of them upon litmus-paper moistened and properly prepared, when, according to the results and manner of sampling, we know off-hand the true condition of the specimen as a whole, or of any particular portion of it; and, knowing this, we learn at once the general affinities of such rocks or portions of rocks, or to particularise whether they are absorbent of acid silicates or silica, or of basic silicates (as the earthy or alkaline ones), or whether, as in the case of clay or clay slate, they are negative to both these classes of bodies.

I may add, in conclusion, that the *rationale* of the new process for the retention of the fertilising constituents of sewage by means of phosphate of alumina is readily explicable by the fact that this is an acid salt (see table); it is thus enabled to chemically absorb all the more basic organic portions of such sewage, these being generally the most valuable for manure, as they are, I believe, the most noxious to animal life.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, April 15th, 1873.

R. Angus Smith, Ph.D., F.R.S., Vice-President, in the Chair.

Mr. William Thompson was elected an Ordinary Member of the Society.

The following letter from Mr. William Boyd Dawkins, F.R.S., was read :—

As Secretary of the Committee of the British Association for carrying on the exploration of the Victoria Cave, I am obliged to notice the "Notes on Victoria Cave," by Mr. W. Brockbank, published in the *Proceedings*, March 10th, 1873, pp. 95 *et seq.* The notes in question are based partly on Mr. Brockbank's examination of the cave during two visits, with an interval of two years between them, partly on the facts recorded by Mr. Tiddeman and myself, and partly on a ground plan constructed by our superintendent, Mr. Jackson, for the Exploration Committee, that is not yet published. I submit that, until the work of the Committee to which the cave has been handed over by the kindness of the owner be finished, and the observations, to which Mr. Brockbank has had no access, be recorded, his notes must of necessity be imperfect and liable to error. How much he is in error as to matters of fact may be estimated by the examination of the statement, p. 97—"the day before my visit a mass of at least 100 tons had fallen from above the face of the Victoria Cave." Mr. Jackson writes me that not even a mass weighing 1 ton, although two blocks possibly of 10 cwts. each, had fallen. The statement at p. 96, in which I am made to differ with Mr. Tiddeman as to the presence of the pleistocene mammalia inside the cave, is altogether unfounded, and the inference that I "varied my description" after my paper came before the Society is negatived by the fact that the abstract in question was printed for private circulation in 1872. The remains occur at the entrance and extend both inside and outside the cave, as

I pointed out in my diagram. These are merely two out of many points which have been raised, and which do not lead me to alter my conviction that the stratum containing the mammalia is of pre-glacial age, or to undertake any responsibility as to the views which I have *not* advanced. Were I to discuss all the points which have been raised, I should anticipate the Report of the Committee to the British Association. If these hasty and necessarily imperfect observations were not calculated to throw discredit on the Exploration, I should not trouble the Society with this note.

"*On some Improvements in Electro-Magnetic Induction Machines*," by HENRY WILDE, Esq. An abstract of this paper will appear in an early number of the CHEMICAL NEWS.

MICROSCOPICAL AND NATURAL HISTORY SECTION.

Extraordinary Meeting, December 11th, 1872.

JOSEPH SIDEBOTHAM, F.R.A.S., in the Chair.

MR. JAMES M. SPENCE exhibited a large and interesting collection of natural history and other objects from Venezuela. Mr. Spence had lately returned from that country, in which he spent eighteen months, during which time he accumulated a very extensive collection.

The natural history collection contained a number of hunter's skins of the larger animals of prey and of the chase; but the great wealth and beauty of the fauna of the country was best illustrated by the extensive collection of birds, which is probably the best ever got together, and embraces examples of nearly all the tribes found in the Venezuelan Republic.

The economical portion of the collection was of great interest and value, chiefly from its extent and the care which had been exercised in its collection and transportation, and the valuable notes of Dr. Ernst of Caracas, which accompany it, rendered it still more valuable. Specimens of the vegetable and mineral productions of Venezuela were to be seen in great number and variety.

Among the plants exhibited was a small collection of *Characeæ* named by Dr. Ernst, but the chief interest was in a small collection of plants gathered by Mr. Spence on the summit of Mount Naiguati.

This mountain, whose altitude is nearly 9,500 feet, is the highest in Venezuela, and was regarded as almost inaccessible until Mr. Spence and five companions made a successful ascent in April, 1872. A species of grass allied to the bamboos, and new to science, was one of the results of this ascent.

The exhibition also included an assortment of interesting curiosities of native manufacture, recent and ancient. There were goblets, drinking cups, and flasks more or less finely carved out of cocoa-nuts, some mounted in silver; and a series of delicately-worked cups and bowls of calabash.

From the State of Trugillo, Mr. Spence has brought three curiously-shaped vessels obtained from Peruvian burial places.

The collection remained open to the public for some days, and was visited by a large number of persons.

January 27th, 1873.

Professor W. C. WILLIAMSON, F.R.S., President, in the Chair.

"*Description of Minerals and Ores from Venezuela*," by JOHN PLANT, F.G.S.

The collection of minerals acquired by Mr. J. M. Spence during his residence at Caracas, and on several journeys along the coast, came from the provinces of Barcelona, Bolivar, Carabobo, and Coro, with a few obtained from the regions of the river Oronoco and Lake Maracaibo. The collection contains gold in quartz of very rich character, argentiferous ores, green and blue carbonates of copper, copper pyrites, galena, iron ores of various kinds, carbonaceous minerals, calcites, silicas, and rock specimens of gneiss, mica, talc schists, kaolin, hornblendic rocks, and serpentine, with a few imperfect fossil and silicified woods.

The gold quartz of the richest kind came from the province of Guayana, where vast regions of auriferous rocks occur; and where also gold is found in small grains, flakes, and nuggets of all sizes from an ounce to many pounds weight, in a clay from 2 to 8 inches thick, as well as in a red peroxidated iron earth, both probably alluvial drifts. The quartz veins are richly impregnated with gold in crystals and strings, as may be seen in specimens in the collection. Other specimens of the gold rocks come from the Isle of Aruba, and Loro Estado, Tacasumino.

The argentiferous ores are galenas and cupriferous, and are not of very great richness; they are from La Guaira, Cumanà, and Coro, where decomposed galenas are worked for silver.

The copper ores include twenty specimens from mines that have been worked with profit, one of which, the Aroa mines in the province of Yaracui, is the most famous for the superior richness of its carbonates. The specimen of cuprite from this mine or Quebrada has some long and beautiful crystals of olivenite with cubes of strontian, and from Aragua are specimens of pyrargyrite or red silver ore; others from Caracas, Coro, and the river Tui, include malachites and a native sulphate of copper, probably a crystallisation from the waters issuing from the mines. The chalcopyrites are neither numerous nor very good; the best comes from the Aroa mines, the small granular pyrites appears to be most abundant in a decomposing gneissoze rock.

The galenas are from mines at Los Teques, Aroa, and Campano; several are pseudomorphous crystals in filmy aggregations, interesting specimens for the mineralogist.

The iron ores include specimens of pyrites (mundic) which in Venezuela appears to be as abundant as in most palæozoic regions; ten of the samples are rich, and would be profitable if the cost of mining is not too expensive at Barquisimeto, Caracas, and the Aroa mines.

The hæmatites include specular, micaceous, and red iron ores, all comparable to the best European ores. The limnites comprise bog-iron ore of recent formation and a brown amorphous ore. The siderites include an aggregation of tabular crystals from Caracas, probably a carbonate of protoxide of iron valuable in making steel, and massive clay ironstones from the districts of Corui Machate, where coal is also worked. The crystallised and compact magnetites come from the same place. A thin vein of brown siliceous ironstone has its surfaces covered with minute fragments of clear quartz, singular and beautiful under the microscope.

The carbonaceous minerals are coals, graphite, sulphur, asphaltum, and petroleum. The coals are from Nuevo Mundo, where Mr. Spence has proved the existence of workable coals, the Island of Toas in the Lake Maraciabo, and a cannel coal from Coro, with several black shales from these localities. These coals are undoubtedly of excellent quality, and from report can be worked economically; their age is at present unknown, from the want of any proper geological survey, and in the absence of fossils of any kind in the shales in this collection; in all probability, however, the Venezuelan coals are of true carboniferous age.

The graphite from Caracas is an impure, amorphous, earthy kind, in schists of 2 inches thick, occuring in talcose and micaceous rocks. The sulphurs are massive and of good quality from Campano, Cumanà, and Coro. Asphaltum and its varieties are reported to be found on the coasts in great deposits and in springs: the specimens in the collection are of excellent quality.

The twelve rock specimens of quartz crystals include some of equal purity and size to those obtained from

Brazil. The marbles are of inferior quality and quite devoid of colour and beauty; but in the International Exhibition of 1862 some excellent green and red marbles were shown.

The predominating rocks of the mountain ranges in Venezuela are palæozoic, metamorphosed talcose and chloritic slates, with great layers of gneiss; and within this range along the line of faults and in veins, are found an endless variety of minerals, of which the collection contains asbestos, serpentine, talc, hornblende chlorite, kaolin, felspar, and selenite.

Amongst the comparatively recent rocks are stalactites, salt, marl, alum, gypsum, and many calcareous deposits from the sea shores and fresh-water lakes.

The special collection made by Mr. Spence during a visit to the Island of Orchilia is interesting to the geologist. It contains sufficient specimens to decide the main geological character of the island to be entirely metamorphic gneiss, overlaid with modern calcareous tufas.

The collection includes a number of crude guanos, phosphates of lime, alumina and *urao*, a sesquicarbonate of soda—all of commercial value, and sources of prosperity if efficiently worked.

February 24th, 1873.

JOSEPH SIDEBOTHAM, F.R.A.S., in the Chair.

JOSEPH SIDEBOTHAM F.R.A.S., exhibited an old microscope sent by Mr. Rideout, and explained its construction. The workmanship of the brass-work was very beautiful, and the various motions and appliances much admired. He also read a letter from Mr. Dancer, who for several reasons thought that the microscope was not more than 120 years old, and was made by the elder Adams. He said that many of these old microscopes, in finish of brass-work, good fitting, and screws, would compare very favourably with instruments of recent construction, and that the appliances and apparatus of one of the complete microscopes would surprise a microscopist of the present day; he would find many parts and adaptations which are generally supposed to be of modern invention.

The stand of the microscope is of ebony, and is a fine specimen of geometrical turning. The optical part is of course very poor, and inferior to the very cheapest achromatic instrument of the present day.

Adulteration of Food Act.—The following is the Report of the Analyst, Thomas Stevenson, M.D., to the Vestry of St. Pancras, Middlesex, for the quarter ending March 25th, 1873:—"In accordance with the 7th section of 'An Act to Amend the Law for the Prevention of Adulteration of Food and Drink, and of Drugs,' I beg to submit to you this, my first report. As my appointment dates only from February 1st, 1873, and operations were not commenced until I had received instructions from the Sanitary Committee, this report really refers to a period of half a quarter. The following is a tabular statement of the articles analysed by me during the quarter under notice:—

(1). Articles of Food—		
Bread	34	samples.
(2). Articles of or for Drink—		
Tea	13	,,
(3). Drugs	0	,,
Total	47	,,

Of the samples of bread, eight were in my opinion adulterated, and twenty-six not adulterated. The adulteration consisted in every case in the admixture of alum, a substance used for conferring whiteness and improved texture on loaves made of inferior flour. I am of opinion that the habitual use of alum in bread is deleterious and injurious to health; hence my certificates embodied a statement to that effect. Of the eight adulterated samples, three were duplicates procured by the instructions of the Sanitary Committee from bakers who had previously sold adulterated bread. In all, four samples were thus analysed a second time. In three instances, the second samples were found to be again adulterated, though to a very modified degree; and in the fourth instance, the adulterant used (alum) was present to such a trivial extent that its presence might have been accidental. In view of the above circumstances, I did not feel called upon to recommend any prosecution for the adulteration of bread. I trust that those bakers who had adulterated may be warned by samples having been procured for analysis, and that they will cease to adulterate so important an article of diet as bread. The quality of bread analysed was in all cases household bread, sold by weight, at from 6½d. to 8d. per 4 lb. loaf. Of tea, four samples were in my opinion adulterated, and nine not adulterated. In one case, the adulteration consisted in the admixture of a gritty earthy matter ingeniously rolled up inside the tea-leaves, so that to the eye the tea had a clean appearance. A second sample of (this?) tea was procured, but the adulteration had disappeared. Had the tea been again adulterated, I should have advised prosecution. The three other adulterated samples were mixed with leaves other than tea leaves, the foreign leaves being broken up, so as in a great measure to prevent their identification. Two of the samples were similar samples procured from the same shop. A duplicate sample will also be procured from the shop from which the third sample came, and will be reported on next quarter. The teas analysed were common and inferior black teas at 2s. per lb., and tea-dust at from 1s. 4d. to 2s. per lb.; such teas as are purchased by the poorer classes of the population. I did not in any case advise a prosecution for the adulteration of tea; for, in the first place, I did not feel clear that the adulterations had been executed in this country; and secondly, the adulterations were not injurious to health. Nor were the added substances in large amount. It must not be supposed that, because I have not hitherto advised any prosecution, that I in any way intend to condone adulteration. A very recent decision of a magistrate clearly shows that a non-injurious mixture is illegal. When the Act becomes well-known, I shall feel it my duty to advise prosecution in all cases where I believe the admixture to be fraudulent. Of the samples analysed, forty-six were purchased by the Inspectors and one by a private purchaser. This was a sample of bread brought to my house in an irregular manner on the first day of my appointment. I did not feel justified in refusing to analyse the sample, though I gave no certificate, no fee having been paid. It will be observed that I have thought it right to commence my analyses with the common food of the common people. I here tabulate the results of the analyses:—

Nature of Sample.	Number of Sample.	Unadulterated.	Adulterated.	Nature of Adulteration.
Bread	34	26	8	Alum in all cases.
Tea	13	9	4	Grit, 1; foreign leaves, 3.

The Inspectors have, I believe, ably carried out your instructions, and have met with no difficulty in procuring samples, as they inform me impartially from the vendors of the articles analysed.—Sanitary Department, 10, Edward Street, Hampstead Road, N.W., April 1st, 1873."

Fusion of Platinum.—M. Violette communicates the fact that he has succeeded in fusing platinum. The draught of the furnace employed was very powerful, and the Hessian crucibles employed for the purpose, though lined with plumbago, were partially fused. The results of the experiments were stated as follows:—In a crucible of this kind 50 grms. of platinum were placed, partly spongy and partly in fragments, and after an hour's stay in the furnace the crucible was withdrawn, and at the bottom there was found a perfectly melted button of platinum of the same weight.—*Journal of the Franklin Institute.*

THE CHEMICAL NEWS.

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ANALYSIS OF ANIMAL CHARCOAL.

By ALEXANDER S. WILSON.

IN a recent number of the CHEMICAL NEWS (vol. xxvii., p. 111) a startling statement was made by Mr. T. L. Patterson to the effect that animal charcoal or bone-black, prepared by exposing bones to a red heat for many hours, contains a large proportion of organic matter; while he further affirms that the moisture in the charcoal must not be estimated at a higher temperature than 212° F., because a greater degree of heat would decompose the organic matter.

On the other hand, it has been affirmed by Dr. Wallace that water in new charcoal is only partially expelled at 212°, and that a much higher temperature is necessary for its complete removal; that, of the nitrogen in the charcoal, a minute proportion only exists as ammonia; and that the matter reported in analyses as carbon (nitrogenous) should be estimated by adding to the insoluble carbonaceous matter the amount of nitrogen that has been removed in the treatment of the charcoal with hydrochloric acid.

Having given some attention to this subject, I was induced, by Mr. Patterson's remarks, to make the following experiments, with a view to obtain some more information on the point. A sample of new charcoal (probably of foreign manufacture) was selected, and subjected to the following experiments:—

(1). A quantity of the sample was ignited, and afterwards treated with ammonium carbonate to insure that no carbonic acid was driven off. The loss was found to be 19·02 per cent.

(2). The insoluble in HCl was determined, and the mean of several experiments gave 13·20 per cent. This insoluble was ignited, and gave 2·35 as the mean percentage of ash or silica; this, subtracted from the former amount, gives 10·75 per cent of what is usually reported as carbon.

(3). The amount of nitrogen in this so-called carbon was estimated, and found to be 0·39 in 100 parts of charcoal.

(4). The total quantity of nitrogen in the charcoal was found to be 0·52 per cent.

(5). The water was estimated directly, in an arrangement by which a current of perfectly dry air was passed over a weighed quantity of the sample, placed in a platinum boat in a tube which was heated during the experiment. This air was then deprived of the moisture it had taken up from the char by being passed through a chloride of calcium tube. Three careful experiments gave, respectively, 7·42, 7·45, and 7·57 per cent. In two of these experiments, a small Bunsen was used to heat the tube containing the boat with the char, and in the third an argand; but in none of them could the heat have been sufficient to convert any hydrogen that might exist in the char, either free or combined, into water; and further, as the amount of hydrogen in charcoal is always very minute, there could not be much chance of error from this cause. The calcium tube was small and of that form in which most of the water is received into a bulb, and does not pass into the solid chloride. The water was in this case removed from the bulb and examined; it was alkaline, and gave, on evaporation, a distinct residue of organic matter, too minute, however, to affect the balance, and consequently to impair the accuracy of the above results.

(6). Another quantity of the sample was treated in the same manner as that in the above, except that the current of air from the char was passed through dilute HCl. The amount of ammonia absorbed was found to be 0·05 per cent, so that, even were the whole of this amount retained by the calcium chloride, the above results (5) would only be lowered by 0·05 per cent.

	Per cent.
(7). The loss of weight at 212° F. in 5 hours was	4·73
,, ,, 350° ,, ½ ,,	6·10
,, ,, 360° ,, ,, ,,	6·45
,, ,, 500° ,, ,, ,,	7·53

These results appear to show that Mr. Patterson's "organic matter" consists chiefly of water, which is not expelled at 212°.

The method of analysis pursued gives the following results:—

Insoluble carbonaceous matter..	10·75
Nitrogen removed by dissolving in acid	0·13
Carbon (nitrogenous)..	10·88
Water by direct estimation ..	7·48
Unaccounted for..	0·66
Loss on ignition	19·02

According to Mr. Patterson's method, we should have—

Carbon, including some insoluble organic matter..	10·75
Organic matter dissolved	3·54
Water at 212°	4·73
Loss on ignition	19·02

Further estimations of the insoluble, obtained by treating the charcoal with caustic soda to dissolve the so-called insoluble organic matter, show that this organic matter is nearly, if not absolutely, equivalent to the 0·39 of nitrogen found in the insoluble, and that any other insoluble organic matter must be very inconsiderable indeed. This agrees with Mr. Patterson's experience, for he says that only a small portion of the organic matter is insoluble in acid.

Any organic matter, then, other than nitrogen, that may be found in charcoal must consist chiefly, if not entirely, of the constituents of bone-tar, and traces of ammonia which must necessarily be retained from the distillation of the char; hence arises the necessity of washing and reburning charcoal before employing it in sugar refining. I may add that previous experience gives a larger proportion of nitrogen in new charcoal than was found in the sample selected for the present experiments.

A FEW FACTS CONCERNING BLEACHING-POWDER.

By GEORGE E. DAVIS.

NEVER was there such a difference of opinion over any material of common occurrence as over the constitution of bleaching-powder. While we have one chemist giving it the formula $CaOCl_2$, another demonstrates clearly that it contains two molecules of constitutional water; but this formula is denied by others, who imperatively assert that this extraordinary compound is really but a mixture of calcium chloride and calcium hypochlorite, and that formula given generally excludes any constitutional water; but later still, after keeping these formulæ for a number of years, another chemist tells us that it is composed of 2 molecules of calcium chloride, and 1 molecule of calcium hypochlorite. Now, leaving criticism to abler heads, I beg to state the results of a series of experiments I undertook in 1872, in reference to a difficulty which occurred in the manufacture of bleaching-powder; but first I will state the methods I employed for making the various estimations.

The *active chlorine* was estimated by a solution of arsenious acid, and duplicate analyses were made by

Bunsen's method with iodide of potassium, and estimating the liberated iodine with sodium hyposulphite. Another portion was taken and, after digesting in water, hydrogen sulphite was added in slight excess. At first I boiled the solution to expel the excess of hydrogen sulphite, but as I fancied there was a possibility of losing traces of hydrogen chloride, that method was discontinued, and the excess of hydrogen sulphite was eliminated by oxidisation with potassium permanganate, the solution was then made neutral, and the *total chlorine* estimated with silver nitrate and potassium chromate as an indicator.

Three estimations were made of the lime; first, that which entered the solution; second, the lime in state as hydrate; and thirdly, that which was in combination with the carbonic acid.

A weighed quantity of the bleaching-powder was taken and ground as fine as possible with water, and let digest with frequent shaking for twelve hours; it was then poured upon a filter, so arranged that it was washed without exposure to the air. The washing was stopped when the filtrate contained only traces of chlorine, as it was useless continuing the application of water when nothing but the slightly soluble lime was being washed out. The active chlorine being destroyed in the solution, the lime was precipitated by ammonium oxalate, and its amount determined by potassium permanganate. The residue on the filter was then boiled in a cane-sugar solution repeatedly until all the calcium hydrate was extracted. The lime in this solution was estimated by the combined oxalic acid and potassium permanganate methods.

Nothing remained now but calcium carbonate, alumina, and ferric oxide, with the silica and insoluble matter (and, as appeared afterwards by the control analysis, traces of lime. The lime combined with carbonic acid was estimated as above, and the carbonic acid was estimated by absorption in A. H. Elliot's tubes, and afterwards weighed. The iron oxide and alumina, and the silica and insoluble matter, were estimated by the ordinary methods.

The lime I experimented with had been slaked, and sieved through a 28 hole sieve; it possessed the following composition :—

Calcium hydrate	94·471
Calcium carbonate	0·836
Alumina	0·629
Ferric oxide	0·159
Water, by difference	3·531
Insoluble (clay, sand, &c.)	0·374
	100·000

Traces of manganese and magnesia.

This lime was taken and placed half an inch deep on a leaden table standing over concentrated oil of vitriol, the cover of the table forming the chamber, and the oil of vitriol standing about four inches deep, luted it; the top of the chamber was about eight inches above the table.

Chlorine was then evolved from commercial 70 per cent manganese and hydrogen chloride, and then passed through two U-tubes containing chloride of calcium fused with a little free lime; the gas then passed through another U-tube filled with very porous calcium chloride, and after being led up a tall glass column filled with small coke, moistened with oil of vitriol, entered the chamber.

The chamber, after having stood for thirty-six hours, was still full of gas, so the sample was mixed thoroughly, and then the following analysis was made :—

Active chlorine	39·760
Total chlorine	39·760
Insoluble matter	0·218
Carbonic acid	1·340
Oxide of iron and alumina	0·500
Water by difference	15·062
Calcium oxide (total)	43·120
Calcium oxide (soluble)	31·622
Calcium oxide (combined with CO_2)	3·389
Calcium oxide (as hydrate)	8·000

These lime determinations were made several times, as I could not account for the large quantity of CaO which the sugar solution would not extract; but as they came very nearly alike each time I came to the conclusion that either the lime existed as an orthocarbonate, Ca_2CO_4, or else that salt was formed when I boiled the hydrate and the carbonate together.

If the lime is taken simply as monocarbonate and calculated from the carbonic acid obtained, and leaving the excess as hydrate, the above would probably represent—

Hydrated calcium chloroxide ($CaH_2O_2Cl_2$)	81·200
Hydrated calcium oxide (CaH_2O_2)	13·287
Calcium carbonate	3·046
Water by difference	1·749
Ferric oxide and alumina	0·500
Insoluble	0·218
	100·000

When this strength was reached, fresh chlorine was again passed into the chamber; but this time the calcium chloride tubes were taken away, so the chlorine was passed only up the coke column moistened with sulphuric acid.

After standing in the atmosphere of chlorine for two days the bleaching-powder was examined with the following results :—

Total chlorine	42·851
Active chlorine	39·051
Lime (total)	43·400
Carbonic acid	1·513
Oxide of iron and alumina	0·524
Insoluble	0·220
Water by difference	11·492
	100·000

This experiment seems to teach that calcium chloride when finely divided gives up its water to concentrated oil of vitriol as the water has decreased, as the difference between the total and active chlorine has increased; and if this is really the case, and if the active chlorine be a constituent of calcium hypochlorite and chloride in the powder, why is it that by prolonged standing over the oil of vitriol a relative proportion of water is not eliminated? Simply because the active chlorine is in combination both with the water and lime; and the only chloride of calcium which bleaching-powder contains is that which is formed by direct combination of the hydrogen chloride (which is carried over mechanically with the chlorine in the manufacture) with the lime. The hydrogen chloride, which is necessary for the formation of the calcium chloride, may not exist originally in the gas; but if the chlorine is moist and warm hydrogen chloride will be formed by the mutual reaction of the water and itself.

After the above experiment was performed, the chamber was again closed and filled up with chlorine, no tubes were placed between the still and the chamber, nor was the coke column used; the gas entered the chamber as it left the still.

The above experiment was performed upon only half the powder, the other half was placed in a stoppered bottle and sealed round with paraffin.

The gas after standing for a day was not absorbed, so the chamber was opened, and the following determinations of the chlorine were made :—

Total chlorine	44·73
Active chlorine	37·87

The other half of the powder was then taken and placed upon the clean table over the oil of vitriol, and the still was charged with a mixture of 4 parts of manganese to 1 of dolomite, with the requisite quantity of hydrogen chloride. After allowing the chamber to stand for two days, it having been filled up with the mixed gas, a sample was taken out and the following analysis made :—

Total chlorine	38·342
Active chlorine	35·710
Carbonic acid	3·313

No further experiments were made with this sample of powder, so the chamber was emptied, and charged again with fresh slaked and sieved lime of the same composition as before.

Instead of luting the chamber with strong vitriol, weak acid of a specific gravity 1·4 was used.

The still was charged with manganese and hydrochloric acid, and the evolved chlorine led through the calcium-chloride tubes as in the last series of experiments. The gas was thus pure and dry, but the dryness was not required, as I only wished to try the action of pure moist gas upon the slaked lime. When the chlorine left the calcium-chloride tubes, it was conducted through a Wolff's bottle containing water kept at a temperature of 17° C. by means of a water-bath; the gas then passed into the chamber.

When the still was exhausted, the chamber was opened, and the powder examined, with the following results:—

Total chlorine	33·867
Active chlorine	31·645
Lime	44·800
Carbon dioxide	0·347

This latter was a light, but rather moist, powder, which rubbed to a putty between the fingers (the rule-of-thumb test for a good powder), whilst that produced by the former experiment would not rub to a paste, although it contained 39·76 per cent of chlorine.

The chamber was again closed, filled up with fresh chlorine in a way similar to the last, and let stand for twenty-four hours. The chamber was then opened, and the powder examined. It contained—

Total chlorine	35·556
Active chlorine	33·333
Lime	43·260
Carbon dioxide	1·046

The powder upon the table was well mixed, and chlorine again passed in, but this time the U-tubes only were used, the water-bottle being taken out of the circuit, so that the chlorine entered the chamber pure and dry.

After allowing the chamber to stand filled as above for two days, the following estimations were made:—

Total chlorine	36·684
Active chlorine	33·560

This fact proves that if a powder is allowed to gain an excess of water (that is to say, a large excess) over and above that which is necessary to form the hydrate of lime, either through too much water being used in slaking, or through the medium of the chlorine itself in the shape of steam, that it is impossible to increase the percentage of active chlorine to any extent by the admission of more chlorine, even though it be pure and dry, and this was perfectly demonstrated by an experiment upon the large scale, which I tried soon after I had arrived at the above conclusion—

The top soft cake from a chamber of nearly finished powder was well mixed, and the following analysis made:—

Total chlorine	36·72
Active chlorine	34·55

About 500 grms. were finely powdered, and placed upon a table in the chamber, which latter was 58 feet in length, 28 feet in width, and 6 feet high. The sample was distributed over a surface of 4 square feet with a fine laboratory sieve, and the gas was then turned into the chamber. In this experiment I expected all the free hydrate of lime to be saturated with chlorine, but the total chlorine only came out 36·84, and the active chlorine remained the same. This experiment was made at a time when the manufacture was carried on in the most reckless and absurd manner possible; the gas was entering the chamber saturated, and often supersaturated, with moisture and hydrochloric acid, and, although improvements in the practical working were being effected, still the introduction of so much steam into the chamber must have influenced the result. Now the presence of so much free hydrate of lime has often exacted from me the query—Does bleaching-powder for its constitution depend upon this large excess of lime? At first sight this seems probable, but on further investigation this probability disappears, without we assign to bleaching-powder a formula in harmony with its complete analysis, and assume that, like many other salts, it is decomposed in presence of water, and split up into those compounds which we find in its solution.

Now the bleaching-liquor of commerce may be taken as illustrating the above—free lime exists not in any quantity, and if the active chlorine be taken and calculated into calcium chloroxide, and the difference between the active and total converted into calcium chloride, nearly all the lime is taken up.

In order to show this, the following is the analysis of a bleaching-liquor, clear, and of a specific gravity 1·13.

Calcium chloroxide ($CaOCl_2$) ..	13·524
Calcium chloride	1·166
Lime	0·392
Manganese	traces
Water, by difference	84·918
	100·000

The next is the analysis of a bleaching-liquor, which turned out to be adulterated with sodium chloride, and this shows how foolish it is for users of this article to *prefer the rule-of-thumb to the rule-of-three*—

Calcium chloroxide ($CaOCl_2$) ..	11·684
Calcium chloride	3·219
Sodium chloride	1·638
Lime	0·028
Manganese	traces
Water, by difference	83·431
	100·000

The specific gravity of this latter was 1·155.

The following are some analyses of commercial bleaching-powder; I only give here samples of over 35 per cent, and made by the ordinary process:—

	I.	II.	III.	IV.	V.
Total chlorine ..	36·40	35·54	38·62	37·76	39·52
Active chlorine ..	35·12	35·00	35·50	35·87	36·11

The above we may consider good samples; now follow some bad—

	I.	II.	III.	IV.	V.
Total chlorine ..	33·86	37·24	30·52	30·90	37·51
Active chlorine ..	30·25	31·33	29·46	27·87	32·30

The next three analyses are samples of powder made by Deacon's patent process; they were taken from casks on the consumer's premises—

	I.	II.	III.
Total chlorine ..	37·78	34·93	39·74
Active chlorine ..	29·72	31·42	31·57

Now, in the CHEMICAL NEWS, vol. xxvii., p. 182, Mr. W. C. Reid states that the powder made by Deacon's process does not part with its chlorine so readily as that made by the ordinary process; would he kindly explain how it is that a sample may be examined from a particular shelf and found to contain, say, 27 per cent of active chlorine, and when next examined it turns out to contain only 20 per cent, or even less. I have had only three samples of bleaching-powder by Deacon's process under my observation, and I have no doubt that Mr. Reid would not have made the assertion if the fact did not exist; but certainly I have failed to regard the greater stability of the chlorine as one of the successes of the new process.

Before I conclude, I should like to mention Muspratt's experiments in connection with the formula of bleaching-powder. Muspratt assigns a formula (CaOCl.2HO), or, in a modern formula, $CaOCl_2.2H_2O$; this is 1 molecule of water more than the compound is calculated to in the above analyses. Now there is not water *enough* in the above analysis, even if all was abstracted from the

lime; therefore, I think this formula will not bear looking into, especially as we find that a large excess of water prevents the powder reaching even 35 per cent, and the finished powder contains so much lime, apparently in the uncombined form.

Walsall, April 28, 1873.

ON THE

DETERMINATION OF PHOSPHORIC ACIDS IN PRODUCTS IMPORTANT IN AGRICULTURE AND PHYSIOLOGY.

By M. JOULIN.

The manufacture of superphosphates and the use of artificial manures give rise to transactions of such importance, that commercial analysts are daily called upon to ascertain the value of these products. At first, animal charcoal had so low a value that falsifications were unheard of. As its agricultural worth was discovered, all sorts of matters, black or brown, were mixed with the charcoal, such as peaty clays carbonised. In consequence of these frauds, a laboratory for the analysis of manures was formed at Nantes, of which Professor Bobierre took the direction. As a cheap and rapid method was required, Bobierre adopted the procedure described in his writings, and still known as the "commercial method." It consists in desiccation of the sample, and incineration if needful; solution in dilute nitric acid, precipitation with ammonia in excess; washing, drying, and ignition of the precipitate considered as pure tribasic phosphate of lime. As by degrees mineral phosphates were introduced, this method, barely tolerable for bone products, became utterly untrustworthy. Sophisticators, therefore, bargained that the analysis of their wares should be made by this method. Not only alumina and oxide of iron, when present, but sulphate and carbonate of lime, and even chloride of calcium, were thrown down by the ammonia, and valued as phosphate of lime. In the analysis of a superphosphate by this method, a certain quantity of sulphate will always be found to have accompanied the phosphate. The presence of carbonate is explained by the presence of carbonic acid in the ammonia, or by its absorption from the air during washing. The precipitate also contains chloride of calcium, even when washing has been prolonged till not a trace of turbidity is caused by the addition of nitrate of silver.

The author then gives the result of experiments made to estimate the importance of these various sources of error, independent of the presence of alumina and iron.

A solution of phosphate of soda was taken, measuring 10 c.c., and containing exactly 0·10 grm. of phosphoric acid. An excess of chloride of calcium was added, and the phosphate was thrown down with ammonia free from carbonate. The precipitate was washed with distilled boiling water, first by decantation, and then on a filter, till the washings were not rendered turbid either by nitrate of silver or oxalate of ammonia. The precipitate, after ignition, weighed 0·250 grm., which, if pure phosphate of lime, would contain 0·11724 grm. of phosphoric acid, an error of more than 17 per cent. The precipitate, on resolution in dilute nitric acid, effervesced distinctly, and the solution was rendered turbid by nitrate of silver. The chances of error in this method are all against the buyer.

A variety of methods have since been proposed, none of which have become general.

Boussingault removes the lime by means of sulphuric acid in presence of alcohol. In the clear filtrate, the phosphoric acid is determined as ammoniaco-magnesian phosphate, by the addition of a salt of magnesia and ammonia after the alcohol has been expelled by prolonged ebullition. If iron or magnesia is present, its precipitation is prevented by the addition of a little tartaric acid. The process is exact, but requires much time and manipulative skill.

It has been proposed to dissolve the substance in nitric acid in presence of a known excess of pure tin. The stannic acid formed, which contains the whole of the phosphoric acid, is washed, dried, ignited, and weighed, deducting from the amount thus obtained the weight of stannic acid yielded by the same weight of tin similarly treated without phosphoric acid. This process, if well managed, gives, in certain cases, excellent results. The presence of sulphates determines an important error in excess.

The method of Chancel, in which the phosphoric acid is determined as phosphate of bismuth, has been adopted by many analysts. It is rapid and easy, and would deserve preference if it were of general application. Unfortunately it is incorrect in presence of sulphates and chlorides, the preliminary removal of which is tedious and delicate. Further, the phosphate of bismuth carries down with it small quantities of alumina and iron, even in presence of free nitric acid. If the acid be much increased to get rid of this difficulty, the phosphate of bismuth is partially dissolved; the method must therefore be rejected.

The determination of phosphoric acid by the molybdate of ammonia process is remarkably exact, but is most applicable to the determination of small amounts of phosphoric acid in presence of large quantities of iron and alumina. In ordinary cases, it is too tedious and expensive.

Otto recognised the fact that, in presence of an excess of tartaric acid, the hydrochloric and nitric solutions of peroxide of iron and alumina are not precipitated by ammonia. It is then possible to separate the phosphoric acid as an ammoniaco-magnesian phosphate on adding a salt of magnesia and some ammonia. If the amount of iron and alumina present is large, the precipitate formed may retain traces of them. It generally contains subtartrate of magnesia, which is converted into caustic magnesia on ignition, and augments the weight of the precipitate. Hence the admitted necessity of re-dissolving the precipitate, and re-precipitating with ammonia along with a little tartaric acid. If lime is present it must be previously removed by means of sulphuric acid and alcohol, or oxalate of ammonia and acetic acid. This method has not been widely employed, on account of its tediousness.

Some years ago, Warington proposed the substitution of citric for tartaric acid, on account of the greater solubility of the citrate of magnesia.

Recently, Brassier has discovered that phosphate of lime is very soluble in citrate of ammonia, and that in consequence the preliminary separation of the lime may be dispensed with. The following is his method:—

The hydrochloric solution of the phosphates is precipitated with excess of ammonia; the precipitate is redissolved in citric acid, though the liquid is still maintained ammoniacal. Pure chloride of magnesium is then added in a sufficient quantity to obtain all the phosphoric acid in the state of double phosphate. The whole of it is thus thrown down without a trace of lime. The precipitate is collected on a filter, washed with ammoniacal water, and ignited. This method is, however, only applicable when the substance is free from sulphates, as otherwise sulphate of lime is thrown down in the ammoniacal liquid. Even in other cases the results obtained do not always correspond. To give exact account of these variations, experiments were made, from which the author draws the following conclusions:—

(1). The preparation of phosphoric acid is complete in a liquor containing twenty-five to fifty times as much citric acid as phosphoric, provided that the chloride of magnesium is in excess. The best results were obtained when the weight of the citric acid was twenty-five times greater than that of the phosphoric, and when the mag-

nesian salt was only one-half more than was strictly necessary.

(2). A very large excess of the magnesian salt causes an error of excess.

(3). A very large excess of citrate of ammonia causes an error of deficiency.

(4). Simultaneous augmentation of the magnesian salt and the citrate of ammonia causes the error to disappear. Hence it is quite intelligible that the results of different chemists are apt to differ, as nothing indicates the quantities of the reagents to be employed. The presence of sulphate of lime causes an error in excess which may exceed 2 per cent.

Chloride of calcium, a compound nearly universal in the solutions of phosphatic minerals, is also liable to cause an error of excess.

These imperfections are more decided if oxide of iron and alumina are also present.

The author considers that he has overcome these difficulties by the use of the following precipitating solution :—

Citric acid	400 grms.
Carbonate of magnesia	20 ,,
Distilled water	200 ,,

When the carbonate of magnesia is quite dissolved, 500 cubic centimetres of ammonia at 22° Baumé are added. The liquid heats, and the rest of the citric acid dissolves. It is allowed to cool, and is made up to the volume of a litre with distilled water, filtering if needful. The solution is permanent; it is decidedly acid, but only heats slightly when mixed with a large excess of ammonia. The precipitate thrown down by this liquid is re-dissolved on the filter with dilute nitric acid, re-precipitated with ammonia, collected and washed anew, ignited, and weighed.

An equally accurate result may be obtained with greater speed by determining the phosphoric acid contained in the precipitate volumetrically, by means of a standard solution of the nitrate of uranium.

(1). All phosphates in an aqueous solution are thrown down by a solution of nitrate of uranium, and the precipitate is perfectly insoluble in water, even if acidulated with acetic acid. It dissolves, however, in dilute nitric and hydrochloric acids.

(2). If the liquid contains ammoniacal salts, the precipitate formed is ammoniaco-phosphate of uranium, containing 2 equivalents of oxide of uranium to 1 of phosphoric acid.

In the absence of ammoniacal salts, but in presence of alkaline acetates, the precipitate has the same composition.

(3). If neither of these two classes of salts be present, the precipitate contains 3 equivalents of oxide of uranium to 1 of phosphoric acid.

(4). The slightest traces of a uranic salt are shown by the formation of a chocolate-brown precipitate when a drop of the solution is placed in the middle of a drop of solution of ferrocyanide of potassium on a slab of white porcelain.

(5). Uranic phosphates held in suspension in water, or very dilute acetic acid, cause no colouration in ferrocyanide solutions.

A. *Preparation of the Normal Solution of Phosphoric Acid.*—A dilute solution of phosphate of soda is precipitated by a solution of sulphate of magnesia, hydrochlorate of ammonia, and ammonia. The precipitate is washed with distilled water containing 10 per cent of ammonia, first by decantation, and then on a filter, and dried at 100°. It is then removed from the filter, and heated to dull redness in a platinum crucible. At the end of the operation the temperature is raised higher. It is then cooled, and the pyrophosphate of magnesia preserved in a well-stoppered bottle. To prepare the standard solution, 3·127 grammes of the pyrophosphate (containing 2 grammes of phosphoric acid) are weighed out, placed in a flat-bottomed flask, in which they are drenched with about 20 cubic centimetres of pure nitric acid. The whole is boiled on the sand-bath for a quarter-of-an-hour, to re-convert the phosphoric acid into its ordinary state. Water is now added, and the liquid is saturated with dilute ammonia until the slight precipitate formed on each addition no longer disappears on shaking. A few drops of nitric acid diluted with 10 parts of water are now added, to re-dissolve the precipitate formed, and the liquid is poured into a test-mixer, and made up with water to 1 litre exactly. The flask in which the pyrophosphate was dissolved is repeatedly washed out with portions of the liquid, which are then poured back into the litre-measure. This solution contains 0·1 gramme of phosphoric acid in 50 cubic centimetres.

B. *Solution of Acetate of Soda.*—One hundred grammes of pure acetate of soda are dissolved in distilled water; 50 cubic centimetres of pure glacial acetic acid are added, and the solution is made up to 1 litre with distilled water.

C. *Solution of Uranium.*—The purity of the nitrate of uranium is tested by dissolving a small quantity in ordinary ether, in which it should be perfectly soluble. To prepare the solution 40 grammes of the nitrate should be placed in a test-mixer, and 500 cubic centimetres of distilled water added. Ammonia is then added till a permanent turbidity appears. This is re-dissolved by means of a few drops of acetic acid; distilled water is added nearly up to the litre mark, and the liquid is set aside for 24 hours. The next day water is added, so as to make up the exact volume of a litre, and the liquid is filtered into the bottle in which it is to be preserved.

In determining the respective value of the standard solutions, it is important that the bulk of the liquid in every experiment should be the same. The addition of the acetate of soda somewhat diminishes the sensibility of the reaction; hence one and the same quantity should always be added. The next step is to find the quantity of solution of uranium necessary to produce the characteristic reaction with ferrocyanide in a given volume of liquid.

To this end drops of the ferrocyanide solution are placed upon a white porcelain plate with the end of a glass rod. These drops should not be more than 5 millimetres in diameter. On the other hand, 75 cubic centimetres of distilled water are measured into a beaker, and a Mohr's burette, graduated into tenths of a cubic centimetre, is filled with the uranium solution. The best way to fill the burette is to plunge its lower opening into the liquid, and suck it up by means of a caoutchouc tube fixed to the top. When the burette is full the liquid is let fall, drop by drop, into the measured quantity of distilled water, stirring after every drop. The end of a glass rod is then lightly moistened with the liquid, and applied to one of the drops of ferrocyanide solution on the porcelain plate. If a slight reddish colouration does not appear in the centre of the drop, more nitrate of uranium is dropped into the water. About ten drops of the solution have to be added before the colouration is produced. A second test is then made, adding to the 70 cubic centimetres of distilled water 5 cubic centimetres of the solution of acetate of soda, and proceeding as above; 20 drops, or 1 cubic centimetre, will now be required before the colouration is produced. This amount is marked on the label of the bottle, and is deducted from the result found in titrating any sample. In determining the value of the standard solutions, 50 cubic centimetres of the phosphoric liquid are put into a beaker of Bohemian glass, and 5 cubic centimetres of the acetate of soda are added. The beaker is then set on a sand-bath, and brought to the boiling-point. Into the boiling liquid 18 centimetres of the uranium solution are poured without testing the liquid. After that it is necessary to test at each half-centimetre till the colouration is obtained. The number of degrees of the burette consumed is then read off. It will often be found that after no colour has been produced, the next half-cubic centimetre will give a deep red. In such a case it is necessary to repeat the trial, testing after every drop when near the point found above, until the very faintest colouration appears. Suppose, *e.g.*, that 21 cubic

centimetres of the uranic solution have been consumed; as 1 cubic centimetre is required to obtain the colouration with the same volume of liquid without phosphate, the amount of uranic liquid which precipitates 0·100 gramme of phosphoric acid is 21 − 1 = 20 cubic centimetres, and each cubic centimetre corresponds to 5 milligrammes of phosphoric acid. For actual analysis it is well to mark the bulk of 75 cubic centimetres, on a sufficient number of beakers.

1st Case.—Phosphates soluble in water and neutral or alkaline. Phosphates of potassa, soda, and ammonia.

Five grammes are weighed and introduced into a flask marked at 100 cubic centimetres. Distilled water is added, and it is dissolved by means of heating and stirring. When the solution is complete, the flask is cooled down to the temperature of the atmosphere, and it is filled exactly up to the mark with distilled water, closed with an india-rubber stopper, and shaken. If the solution is not clear, it is quickly filtered. Should this operation prove tedious, the flask and the filtering-funnel are both covered with a bell-glass, to prevent evaporation. When the liquid is clear 5 or 10 cubic centimetres are taken, by means of a graduated pipette, previously washed with a little of the same solution. The liquid is put into one of the marked flasks, 5 cubic centimetres of acetate of soda solution added, and the volume made up to 75 cubic centimetres with distilled water, and the whole heated to a boil. The nitrate of uranium solution is then dropped in as above, until, on testing, the colour is obtained.

2nd Case.—The phosphate is insoluble in water, but readily soluble in dilute nitric and hydrochloric acids, tribasic and bibasic phosphates of lime, and magnesia and phosphates of iron and alumina.

The substance is powdered, and 5 grammes are weighed out and put in a marked flask as above. A little distilled water is added, and 20 cubic centimetres of dilute nitric acid, applying heat if needful: when the solution is complete it is made up to 100 cubic centimetres with distilled water. It is then shaken up, and filtered exactly as in case 1; 5 cubic centimetres of the solution are taken, put in a beaker, and mixed with 10 cubic centimetres of the citro-magnesian solution, and a large excess of ammonia. The ammonia should give no immediate precipitate, but on stirring a crystalline precipitate of ammoniaco-magnesian phosphate is deposited. It is allowed to settle for 12 hours, and then carefully filtered through paper free from lime and phosphates. The glass which held the precipitate is repeatedly washed with water containing 10 per cent of ammonia, and the liquid each time thrown upon the filter. The precipitate is washed on the filter with ammonia-water. A beaker marked at 75 cubic centimetres is placed under the funnel. The glass in which the double phosphate was precipitated is repeatedly washed with water containing 10 per cent of nitric acid, and the liquid each time poured upon the filter, washing the dissolved precipitate into the flask. The filter is then washed with distilled water. The volume of the liquid in the flask will not exceed 20 to 30 c.c. The liquid is then saturated with ammonia, adding it drop by drop, till the precipitate formed no longer dissolves on stirring. When the liquid remains very faintly turbid, one or two drops of nitric acid are added, to restore the transparency of the liquid. The 5 c.c. of acetate of soda are then added, the liquid made up to 75 c.c. with distilled water, and the titration performed as above. It has been found by direct experiment that the presence of sulphate of lime, chloride of calcium, salts of iron and alumina, whether severally or jointly, has no influence on the result.

We arrive at the following conclusion:—

(1). The precipitation of phosphoric acid with ammonia and magnesia in presence of an excess of citrate of ammonia is an excellent method for separating phosphoric acid from the bases with which it is commonly combined. But if we are satisfied with weighing the precipitate immediately after ignition, we obtain, in the majority of cases, too high a result.

(2). The determination of phosphoric acid with a standard solution of nitrate of uranium, with the precautions pointed out above, gives results perfectly exact when the phosphoric acid is combined with magnesia or alkalies. But if lime, iron, or alumina be present, the results are inaccurate, and generally too low.

(3). By employing the citro-magnesian liquid to separate the phosphoric acid, and the uranic solution to determine it in the precipitate obtained, accurate results are obtained even in presence of an excess of iron and alumina. In a succeeding chapter the author examines the principal applications of the method to the substances most frequently requiring analysis.

THE PHYSOMETER, A NEW INSTRUMENT FOR THE DETERMINATION OF VARYING VOLUMES OF AIR AND OTHER SUBSTANCES.*

(Concluded from p. 216).

THE apparatus described was primarily intended to be used in physiological researches.

In order to estimate the influence of the bladder-membrane on the changes in volume of contained air, the bladder of a large gilthead was filled with air, and the volume of this air, after correction for barometric pressure and temperature, ascertained directly (by weighing in distilled water, &c.), to be 76·403 c.c.

This bladder was put in the physometer-cage, and the cage three several times raised and sunk about 45 c.c. in the cylinder. The positions of the water-column in the measuring-tube are indicated in the following table:—

	Raising.			Sinking.		
	Height of Water-Column in Tube, in m.m.		Diff.	Height of Water-Column in Tube, in m.m.		Diff.
	h_1.	h_2.		h_2.	h_1.	
I. ..	12	201	189	201	9	192
II. ..	8	195	187	195	4	191
III. ..	8	193	185	193	1	192

The mean difference, with necessary corrections, is 191·54. Every millimetre of the scale corresponds with 8·022 centims. Hence, the entire difference of air-volume in the bladder in the two positions = 1536 centims., *i.e.*, about $\frac{1}{50}$th of the entire air-volume contained. Now, deducing from this difference, simply in accordance with Boyle's law, the original volume of the contained air of the bladder under atmospheric pressure, this is found 69·81 c.c., a result which is 7·586 c.c., or 10 per cent, lower than the actual air-volume found directly, a difference too great to be attributed to error in method or observation. There is evidently another cause in action than the increasing pressure of the water. The calculation, according to Boyle's law, supposes a free expansion and contraction, whereas the resistance of the membrane must affect the result. This effect becomes most apparent in using a very dry bladder. At first the raising or sinking of the cage produces hardly any change at all in the measuring-tube; as the membrane becomes saturated, the water-column shows more motion; but, even when it is fully saturated, some allowance must be made. From a considerable number of observations, a *coefficient of inertness (Trägheit)* may be determined, at least for bladders of the same fish species.

It was also found that the bladder in the free state expanded and contracted somewhat more, for the same differences of pressure, than when in the body of the fish. The difference in the case of a tench was about 4 per cent.

Another point to be considered was the possible presence of air in the intestinal canal, which might affect the column in the measuring-tube like the air in the bladder. The fishes were opened after experiment; in

* Abstract of a paper in *Poggendorff's Annalen*, by P. Harting.

only two cases were air-bubbles met with in the intestine, and these were too few and small to be of any importance.

From the above, it appears that only an approximate determination of the entire air-contents in the bladder, when raised and sunk by means of the cage, can be made from observing the height of water in the measuring-tube. Still, this does not affect the value of the apparatus in yielding measurements relatively correct and comparable with each other.

As an example of the observations made, a tench, weighing 0·125 kilo., was put in the apparatus, which was supplied with fresh spring water at a temperature of 10°. At frequent intervals during three days (at the end of which time the fish died) the cage was raised and depressed, and observation made of the measuring-tube. Afterwards the fish was opened, the bladder (still filled with air) was taken out, and a series of physometer observations made with it.

It appears from the tabulated results that, although between individual observations there are considerable inequalities, the average difference in the water-column (from raising and sinking the cage) was in the one case 72·7, and in the other 71·9, showing a close agreement.

The volume of air in the bladder (in free air), estimated by direct method, was compared with the volume calculated from the indications of the instrument by formula, and the coefficient of inertness thus obtained was 1·21. On comparing this with the coefficients of other bladders, the coefficient is found, as might be expected, to increase with the size of the bladder.

Lastly, the air contained in the bladder was analysed. Oxygen had quite disappeared. The constituents were—

N	90·6 per cent
CO_2	9·4 „

Soon after the fish had been put in the apparatus (at 11 a.m.) the volume of air in the bladder was 14·105 c.c. The animal was very sluggish in its movements, and its breathing was slight and irregular; the impure state of the water from which it had been taken had probably been unfavourable to its health. It continued vertical in the cage. Gradually the respiratory movements became fewer, and by about two hours had almost quite ceased, the volume of air being then 12·152 c.c. In the course of the day, however, the breathing was renewed, and the fish revived; and next day, twenty-four hours after it had been put in the apparatus, the quantity of air in the bladder had risen to 14·821 c.c.; five hours later it was 16·709 c.c.; next morning it was 21·158 c.c. The specific gravity of the fish was thus considerably diminished, and, from the position of the bladder in the body, the centre of gravity was so displaced that the animal could not retain the vertical, but was pressed with its right side against the lid of the cage. If the fish were in the normal state, the superfluous air found exit by the *ductus pneumaticus* (as was observed with several of the *Cyprinidæ*), and the vertical position was recovered. But in the present case there was no such liberation of air, and, by the evening of the third day, the quantity was 21·722 c.c. The breathing movements were again very much enfeebled, and it was evident these would soon cease, on account of the failure of oxygen in the water. It was, however, highly probable that the air in the bladder consisted in great part of secreted oxygen, which, when the gill-breathing ceased, would return to the blood. In the following night the fish died, and next morning it still lay somewhat on one side, but not pressed against the inner surface of the lid. The volume of air had diminished to 14·95 c.c., and, as stated above, there was not a trace of oxygen, but about 0·1 of CO_2.

The above case is instanced as showing the use to which the physometer may be put. The number of experiments made is as yet too small to permit of much generalisation.

As to the question whether fishes possess the power of changing their specific gravity by compressing at will the air in their swimming-bladders, experiment did not furnish a sufficient answer. Only with one of the fish (a whiting) there appeared from time to time a sudden sinking, and then rise, of the water-column, which must be attributed apparently to a change of the volume of air through muscular contraction. But these motions in the tube were very small (2 or 3 m.m.), and the changes of volume indicated are much inferior to those which must be considered as due to a slow secretion or absorption of air through the walls of the bladder.

In the case of a perch, the influence of the gill-breathing on the water in the tube was very apparent, each movement of the gills (when the fish was at rest) corresponding to a rise and fall of the column, so that one might count the respirations without seeing the fish. Sometimes the gills would open a little wider than usual, and this, too, had its effect in greater rise and fall of the column. The sensitiveness of the instrument is thus shown.

Not only fishes, but other animals which contain air, might be experimented on with the physometer. If it were practicable to introduce a nautilus into it, some light might be thrown on the disputed question how this animal rises and sinks in the water.

Another use to which the physometer might be put is that of determining the quantity of air in the lungs of the new born, who have breathed only a short time and then died. The results thus obtained would be much more certain than with the simple lung-probe, as the smallest quantity of air might not only be indicated but measured.

Again, the physometer might be employed to make visible the diminution which takes place in muscles during contraction. The wires of an induction apparatus might be connected with the knobs of the brass rods.

For the observation of simple physical phenomena, the physometer might prove serviceable. Two experiments, similar to those with the bladders, were made with the small caoutchouc balloons which, filled with hydrogen, are often used as toys. In the first, the balloon was but slightly distended with air, and the mean difference obtained in the water column from raising and sinking the cage through 115 centims. was 116·65 m.m., which corresponds to 0·9451 c.c. The air volume, directly observed by weighing, was 36·16 c.c., and the volume, as calculated from the physometer experiment by formulæ, was 31·55 c.c., showing the proportion 1 : 1·24.

In the second experiment, the balloon was distended so as to have an air volume of 178·83 c.c., or more than four and a half times as much as in the first experiment. The volume, as calculated from a series of five raisings and sinkings, was 131·09 c.c., showing a proportion to the other of 1 : 1·37. A comparison of these results shows that, with stronger tension of the balloon, its resistance and influence on the expansion and contraction of the enclosed air increase.

But caoutchouc itself, as Wertheim showed many years ago, increases in volume when drawn out. His method of measurement (with compasses) could not give very accurate results. M. Villari last year made similar experiments by a much better method, finding the specific gravity of the same band when extended and when unextended. It might, perhaps, be objected that possibly in the extended caoutchouc microscopically small fissures were produced, into which the air entered, and that this was the cause of the change of specific gravity. With the physometer, this change of volume might be easily rendered visible and measured. The following experiment shows this:—

On the bottom of the glass cylinder was placed a weight of 3 kilogrammes. By an iron hook, two rings of vulcanised caoutchouc were attached to it; a second hook, catching the opposite part of the rings, being attached to the end of one of the brass rods. The diameter and thickness of the rings were very carefully measured, and the volume of both was found to be 5506·88 c.m.m. The apparatus having been filled with water, and all bubbles removed, a measuring tube was inserted, on which each millimetre corresponded to a volume of 3·303 c.m.m. The second brass rod was now pressed down, and thus

the one with the caoutchouc rings raised, till the weight hung free, the rings being extended. The water in the measuring-tube rose about 5 m.m. Allowing the weight and rings to return to their first position, the water column descended to its former height. This was repeated several times, and always with the same result. The increase of volume in the caoutchouc thus indicated was 16·5015 c.m.m., that is, 0·003, or $\frac{1}{1\,3\,3}$ of the original volume. Doubtless with a heavier weight and thinner measuring tube a still greater effect would be obtained.

ON A NEW SENSITIVE FLAME.

By GEORGE J. WARNER, F.C.S.

PERMIT me to call the attention of your readers to the peculiarly sensitive character of a new gas-burner lately introduced into the market.

As Wallace's burner may not yet be universally known, I append a brief note of its construction.

It consists of a hemispherical chamber, into which the gas is introduced through a cone fixed horizontally at a tangent, the position of the jet with regard to the cone being so adjusted that the quantity of air injected by the velocity of the gas at all ordinary pressures is always the proportion required for its perfect combustion.

The upper part of the interior of the chamber is lined with wire gauze, and from it issue one or more tubes, at which the gas is burned. The burner which I have used had only one tube.

At ordinary pressures the flame is of the colour of a Bunsen burner, but with a central cone, clearly defined, of pure green, whether it be turned high or low. But if the gas be reduced below the ordinary pressure on the main, the flame becomes white-tipped, and there is no longer perfect combustion, as in a defective Bunsen. We then find that the flame is sensitive to sound, to all sound in fact, but to high notes particularly.

I consider this a curious fact, as I believe it has been generally supposed that a high pressure is necessary to produce such a flame.

The first effect of the sound is to elevate the flame several inches, after which, if the sound be prolonged, it shrinks down, producing the same perfect combustion as at ordinary pressures, and this continues as long as the sound.

It would appear, therefore, that the gas at a very low velocity does not carry with it sufficient air, and that the effect of the sonorous vibration is to increase the velocity of the gas so long as the vibration continues; so that by sound, by the rattling of a bunch of keys at a distance, we can bring the flame from a state of "imperfect" to one of "perfect" combustion.

Of course the burner is small, burning only about 1½ or 2 cubic feet per hour; but I have a larger one in course of manufacture, which I expect will be infinitely more sensitive.

Ardwick Bridge Chemical Works,
Manchester, May 5, 1873.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 1, 1873.

Dr. ODLING, F.R.S., President, in the Chair.

THE minutes of the previous meeting having been read and confirmed, Messrs. William A. Prout and Alfred Payne were formally admitted Fellows of the Society. The list of donations was then announced, and the names of Messrs. Isidore Bernadotte Lyon and John Henry Baldock read for the third time. These gentlemen were balloted for and duly elected.

Dr. H. SPRENGEL then read his paper "*On a New Class of Explosives*," in which, after stating that Mr. Nobel's important discovery in 1864 of effecting the explosion of nitroglycerine and analogous substances by means of a detonating charge, had initiated a new era in the history of explosives, he observed that an explosion may be regarded as the sudden release of that force which previously held together the molecules of gaseous matter and explosives as those solids and liquids which can suddenly assume the gaseous state. Heat is usually the cause of this change, so that explosions, as a rule, are simply rapid combustions of compounds which yield gaseous products: the higher the temperature produced, of course the more these gases are expanded, and the more powerful the explosion. On examining a large number of mixtures of oxidising and combustible substances, it was found that mixtures of nitric acid, density 1·5, and nitro-compounds of the hydrocarbons, fired by a detonating cap, were the most effective. A mixture of nitrobenzol, or picric acid with nitric acid, exploded with the greatest violence, comparable to nitroglycerine. In conclusion, the author drew attention to the harmlessness of the materials as long as they are kept separate, and the comparative ease with which they may be mixed. Something is gained even when one only of the components is liquid, and with this object he had proposed the use of porous cakes of potassium chlorate, saturated with a combustible liquid, such as bisulphide of carbon or nitrobenzol. These had been found to be five times as effective as an equal weight of gunpowder in open granite quarries.

The PRESIDENT said they were much indebted to Dr. Sprengel for his account of these explosives, and although extremely interesting from a theoretical point of view, the question still remained as to whether they could enter into competition with those with which we are already acquainted.

Professor ABEL said he had witnessed some experiments with Dr. Sprengel's explosives which had been very successful. They no doubt opened out a new field for experiment, although there might be some difficulty in the practical application of corrosive liquids like nitric acid, or volatile ones like bisulphide of carbon. The mechanical state of the explosive had certainly a great influence on the result; for instance, slightly compressed gun-cotton did not detonate readily even if warm, since to obtain a satisfactory result there must be a certain resistance to mechanical motion; but well compressed gun-cotton could be detonated even when wet by employing a small portion of the dry cotton as an initiative; moreover, a low temperature did not in all cases make a difference, frozen gun-cotton detonating readily. When the cotton was so circumstanced that it could resist mechanical motion it was very sensitive to the detonating charge, but when it could yield to mechanical motion it was not sensitive. These conditions had doubtless some bearing in the case of liquid explosives, as might be inferred from the fact that a shell charged with finely-divided gun-cotton suspended in water could readily be exploded by a small detonating charge.

A paper "*On Zirconia*," by J. B. HANNAY, was then read by the Secretary. The author has carefully examined the effect of precipitating zirconia at various temperatures, and finds that when it is formed at a high temperature, a considerable proportion of the precipitate is very difficultly soluble in tartaric acid. This explains the results obtained by Mr. Forbes when examining zircons for jargonium; the supposed new earth, insoluble in tartaric acid, being really zirconia altered by the temperature at which it had been precipitated. Zircons of low sp. gr. were found to contain uranium, iron, cerium, and didymium, besides silica and zirconia. The author also gives an account of the absorption-spectra obtained on gradually heating a borax bead previously saturated with zircon, and to which a little boracic acid had been added. For this

purpose a zirconia light, formed by directing an oxy-hydrogen flame against a cylinder of zirconia was employed, and which the author recommends for spectroscopic purposes, as being extremely good both in the violet and in the extreme red.

Dr. ODLING thanked the author in the name of the Society for his instructive communication on a subject which had excited considerable attention some years ago, and which now seemed to be satisfactorily explained. The difference in the sp. gr. of zircons still offered some points for further investigation.

"*A Note on Pyrogallate of Lead, and on Lead Salts*," by W. H. DEERING, was then read by the author. After glancing at previous examinations of the lead salts of this acid, the author described the method he had employed in preparing the salt, $3PbO,4C_6H_6O_3$, analysed many years ago by Dr. Stenhouse. An aqueous solution of pyrogallic acid, that had been purified by crystallisation from benzol, was acidulated with acetic acid, and precipitated with acetate of lead, sometimes leaving excess of the acid, sometimes using excess of lead acetate; but in both cases the results of the analyses agreed closely with the numbers required by the formula $3PbO,4C_6H_6O_3$. On examination, however, the precipitate was indubitably proved to contain acetic acid; the amount of which corresponded very nearly to that required by the formula—

$$C_{12}H_{10}PbO_6(C_2H_3O_2)2Pb.$$

The precipitate, therefore, is really a combination of pyrogallate and acetate of lead. The author suggested that several of the organic lead salts said to consist of m molecules of lead salt + nPbO, might really be double salts containing acetate of lead.

The PRESIDENT, in thanking the author, observed that his examination of the lead pyrogallate had an important relation to other organic lead compounds, and thus became a subject of general interest.

Dr. WRIGHT said that on decomposing by sulphuretted hydrogen the lead salts of certain acids obtained from the terpenes he had observed the presence of acetic acid: this he had hitherto attributed to the presence of a basic lead salt.

Mr. SPILLER suggested that some light might be thrown on the matter by the mercury salt. Mercury pyrogallate obtained by precipitation with mercury chloride was a scaly crystalline precipitate, an examination of which might give a solution of the question.

Dr. DEBUS observed that it should be a fundamental rule always to qualitatively examine the nature of any given precipitate, so as to ascertain what acids and bases were actually present, and we were much indebted to Mr. Deering for pointing this out so forcibly.

The meeting ultimately adjourned until Thursday, May 15, when there will be a lecture "On Isomerism" by Dr. H. E. Armstrong.

MISCELLANEOUS.

New Civil Engineering College in Japan.—Dr. Edward Divers has been appointed Professor of Chemistry in the Civil Engineering College just established in Yedo by the Japanese Government. There are also Professors of Mathematics, Engineering, and Natural Philosophy, besides teachers of minor subjects. The students have to matriculate in English. The college buildings are built in European style, and include, besides offices and class-rooms, residences for Professors and 300 Students. The laboratories will probably be fitted up, and perhaps built, under the direction of Dr. Divers.

A New Solvent for Iodine.—I find that glacial acetic acid is an excellent solvent for iodine, certainly not inferior to alcohol. On heating acetic acid with excess of iodine to boiling, and then allowing to cool slowly, beautiful large, slender crystals of iodine will form (sometimes half an inch long). The crystals formed from super-saturated alcohol solution of iodine are short, of arrowhead shape, and by no means so abundant, for glacial acetic acid takes up far more iodine hot than cold. I hope you will make this easily executed experiment, and you will then see the finest iodine crystals yet produced. If saturated alcoholic and glacial solutions of iodine are mixed in equal proportions, and allowed to stand, *acetic ether* is formed. The presence of a little MnO_2 and a drop of SO_4H_2 seems to promote the formation, but is quite unnecessary.—Dr. I. WALZ, in the *Journal of the Franklin Institute*.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, April 21, 1873.

Final Reply to P. Secchi.—M. Faye.—On solar physics.

Condensation of Carbonic Oxide and Hydrogen, and of Nitrogen and Hydrogen by the Electric Effluvium.—MM. Thenard.—A mixture of equal volumes of carbonic oxide and of hydrogen was submitted to the electric effluvium; this being the mixture which was formerly given when the electric spark had been passed through an oleaginous mixture containing equal volumes of carbonic acid and protocarburet of hydrogen. The reaction took place more than twice as quickly, an oleaginous mixture of the same aspect being produced, indicating a greater power in the electric effluvium than had been supposed. Next a mixture of hydrogen and nitrogen, in the proportion of 3 to 1, was submitted to the action of the effluvium. In ten minutes traces of ammonia were perceptible by means of litmus-paper, and in two hours they were sensible to the smell. The transformation, however, does not become complete unless an acid is introduced capable of absorbing the ammonia; monohydrated sulphuric acid was employed. Operating on 75 c.c. of gas, kept in circulation, 10 c.c. of mixture were produced in ten hours without acid; and after the introduction of acid 65 c.c. in 13 hours.

Spectral Illuminator.—M. Le Roux.—This is an instrument by which one may vary almost instantaneously the nature of the light illuminating the slit of a collimator. The rays emergent from a prism are received on a movable mirror, and the simple ray required is sent in the proper direction. The prism and mirror, with two collimators in the positions of the incident and emergent rays, are fixed on an articulated parallelogram composed of two lozenge-shaped frames.

Action of Electricity on Flames.—M. Meyreneuf.—Short extract from memoir.

On the Interference Fringes observed with Large Instruments directed to Sirius and several Stars; Consequences which may Result with Reference to the Angular Diameter of these Stars.—Letter by M. Stephan to M. Fizeau.—Some time ago M. Fizeau pointed out, in *Comptes Rendus*, that there was a remarkable relation in most interference phenomena between the dimensions of fringes and those of the luminous source, so that the fringes only appeared where the angular dimensions of the luminous source were almost insensible.

Thus, by observing the fringes formed at the focus of stellar telescopes from separate slits, some new data might be obtained as to the angular diameter of stars. Acting on this suggestion, M. Stephan thus observed one evening a large number of stars, Sirius included, using a telescope with a screen having narrow parallel slits 15 c.c. apart. All the stars gave very intense fringes, those of Sirius, however, being somewhat less distinct. The following evening he used the same telescope with a screen having two lunules placed at the extremities of the same diameter, the inner edges being distant about 50 centimetres. This time Sirius gave no fringes, whatever the magnifying power, while all the other stars gave them. M. Stephan thinks it probable that, though Sirius was somewhat low, this disappearance of fringes was not due to atmospheric influence, but that the diameter of the star will be found not insensible.

Comparison of Electric Machines.—M. Mascart.—An electric machine may be characterised according to two constants—(1) the difference of potential which it is capable of producing between two conductors; (2) the quantity of electricity which it can yield in a given time. The writer has made comparison of eleven different kinds of machine, comprising three Ramsden, one Van Marum, one Nairne, three Holtz, one Carré (with caoutchouc plate), one Armstrong, and the induction coil. A table gives the diameter of the plate, the production per turn, and the production per second.

Condensed "Effluvium" of the Induction Spark.—M. du Moncel.—Reserved for translation.

Influence of Rays of Various Colours in the Spectrum of Chlorophyll.—M. Chautard.—After specifying the changes produced in chlorophyll by light, the writer makes reference to the persistence of green matter in certain plants late in the autumn season; he considers this due to the presence of fatty and resinous matters. He find that a solution of chlorophyll in fixed oils (oil of belladonna, *e.g.*) is not sensibly altered after several days' exposure in full sunlight. The most luminous spectral rays are the most active in changing chlorophyll solution; and rays which have already traversed a layer of chlorophyll have no effect on a second layer so long as the first is not discoloured. In this experiment he used vessels with two or more compartments. Heat modifies chlorophyll, but does not readily destroy it at temperatures under 100°. Above 100° the chlorophyll undergoes various alterations, according to its degree of dryness and the nature of the solvent. Dried chlorophyll is completely disorganised at a temperature about 200°; whereas, solutions of it in essential oils only undergo a slow, gradual change at this temperature, and may even resist 225° or 250° for several hours.

Conditions to be Observed in the Choice of Sources of Water for the Supply of the City of Paris.—M. Belgrand.—An engineering paper. The author seeks conditions under which bicarbonate of lime shall not deposit calcareous incrustations in the mains.

Researches on the Chloride, Bromide, and Iodide of Trichloracetyl.—M. H. Gal.—The material employed in the preparation of these compounds was trichloracetic acid, obtained by treating chloral hydrate with fuming nitric acid. The action of the sun's rays, recommended by M. A. Clermont, the discoverer of the process, is useless. Action of chlorides of phosphorus on trichloracetic acid.—Chloride of trichloracetyl.—This acid was treated with protochloride of phosphorus; reaction was obtained on applying a gentle heat. Hydrochloric acid was given off, phosphorous acid formed, and, on rectifying the distillate, a product was collected boiling at 118° C., which is perchloric aldehyde, and, on treatment with water, gives rise to trichloracetic acid with development of hydrochloric gas. Phosphoric perchloride reacts upon trichloracetic acid with more energy. The chloride of trichloric acetyl is accompanied by oxychloride of phosphorus. The bromide of phosphorus gives corresponding reactions. The bromide of trichloracetyl is a colourless liquid, fuming in the air. If left in an open bottle it soons becomes trichloracetic acid, a change which takes place more rapidly in contact with water. With alcohol, hydrobromic gas is given off in abundance, and, on treating the liquid with a solution of carbonate of soda, we obtain trichloracetic ether. The action of iodine is less decisive, though by means of the tri-iodide of phosphorus a small quantity of a brown liquid was obtained, boiling at 180° C. With alcohol, it yielded hydriodic acid and trichloracetic ether.

Action of Sulphide of Sodium on Glycerine.—M. F. Schlagdenhauffen.—When sulphide of sodium is allowed to act upon glycerine at a gentle heat, a liquid is obtained lighter than water, and having an odour at once ethereal and alliaceous. On heating in a retort on the sand-bath 200 grms. of monosulphide of sodium with 100 grms. of glycerine, water and traces of sulphuretted hydrogen were given off at first. After eighteen to twenty hours, yellowish drops appeared in the neck of the retort, condensing to a light oil in the receiver. The odour of the product recalls at first chloroform and acetic ether. The distillation continues eight hours longer, and the distillate takes an alliaceous odour. On repeating the operation in six retorts, of 1 litre each, 140 grms. of the liquid were obtained, dried by means of chloride of calcium, and submitted to fractional distillation. The first portion passed over limpid between 50° and 70° C., but the boiling-point rose gradually to 200° C. By repeatedly rectifying the first portion, a liquid was obtained, boiling at 58°, sp. gr. 0·825, of an odour recalling that of mercaptan. It was supposed to be hydrosulphate of ethyl, but, on ultimate analysis, its composition was found totally different. Its alcoholic solution precipitates alcoholic solutions of chloride of gold a gelatinous white, nitrate of silver a light yellow, acetate of lead an orange-yellow, and mercuric chloride a white. Nitric acid attacks it with extreme violence, but without yielding the brown oil which is formed in the same reaction with mercaptan. The author is still engaged with the investigation of this compound.

Method of Determining Oxygen in the Peroxide of Hydrogen and in other Liquors by means of a Standard Solution.—F. Hamel.—A known quantity of oxygenated water is put in a suitable vessel, and a standard solution of permanganate of potash is dropped in, the gas given off being collected in a graduated tube. As soon as the water begins to show a colour, the operation is over. The quantity of permanganate employed is read off, and the volume of gas disengaged is measured. The quantity of oxygen, corresponding to 1 c.c. of permanganate, is then found by calculation. A standard solution is thus obtained, which will serve for the direct determination of oxygen in liquids where there are no elements capable of interfering.

Properties and Composition of a Cellular Tissue Found in the Organism of Vertebrate Animals.—A. Muentz.—When the skins of mammiferous animals are exhausted with boiling water, there is left a residue having the original appearance of the skin, but deprived of tenacity. It is formed of conjunctive tissue, mixed with a small quantity of elastic fibres and piliferous bulbs, and retains all the mineral matters belonging to the hide. A characteristic property of this tissue is its solubility in the cupro-ammoniacal liquid of Schweitzer, in the manner of cellulose. It is not attacked by ammonia, but dissolves in it easily in presence of metallic oxides, such as those of copper and zinc. The liquid, neutralised with an acid, deposits flocks, which, when washed and dried, have a horn-like aspect, and retain variable proportions of metallic oxides. The composition of the organic matter is nevertheless constant, whatever may be its origin and the mode of its extraction. It is soluble in ammonia, and also in dilute acids, but only in presence of salts of copper or zinc. Sulphuric acid converts it into glycocoll; with potassa it yields neither tyrosine nor leucine. Its composition

agrees with those of albumenoid bodies. In the subjoined analyses, 1 represents the substance prepared from the skin of a rabbit; 2, from that of an ox; 3, the same, re-dissolved in ammonia, and re-precipitated by acetic acid.

	No. 1.	No. 2.	No. 3.
Carbon	54·61	54·62	54·37
Hydrogen	6·94	6·72	6·85
Nitrogen	14·48	14·31	—

In an analytical point of view, these researches show the method of isolating certain animal or vegetable principles by submitting them to the action of the following reagents, of progressively increasing energy:—Ammonia, ammoniuret of zinc, and ammoniuret of copper. In this manner, albumenoid matters soluble in ammonia alone are separated from those which, like the tissue of the conjunctive, dissolve in it in the presence of the oxide of zinc. Those matters, again, which are insoluble in the two former liquids, but soluble in cupro-ammoniacal liquid, such as silk, are separated by means of the latter. Other substances of the same group, such as wool, insoluble even in the cupreous liquid, are untouched by any of these treatments.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

DELIVERED FROM OCTOBER 5 TO OCTOBER 11, 1872.

Improvements in treating liquors containing ammoniacal compounds in order to obtain products therefrom. James Young, Kelly, Renfrew, N.B. October 10, 1872.—No. 2988. The feature of novelty which constitutes this invention is the heating in a still or boiler the solution of muriate of ammonia resulting from the production of carbonate or bicarbonate of soda by the ammonia process, mixed with the carbonate or carbonates of lime and magnesia, in order to obtain ammonia combined or mixed with carbonic acid.

Improvements in the manufacture of carbonate of soda. James Young, Kelly, Renfrew, N.B. October 10, 1872.—No. 2989. The feature of novelty which constitutes this invention is the passing of carbonic acid through a solution of sulphuret of sodium, the solution being kept at or near the boiling-point in close vessels.

Improved means and apparatus for drying sewage, and other like substances. William Astrop, paper maker, 27, Oriel Road, Homerton, Middlesex. October 10, 1872.—No. 2991. This invention relates especially to the separation of the liquid from, and the drying of the solid portion of the sewage or other like substance. The solid is separated from the liquid matter by precipitation in the ordinary settling tanks used for such purpose, but preference is given to those in which a partial vacuum is employed under the false bottom of such settling tank. The solids are dried by means of a centrifugal machine, the cage of which may be lined internally with felt cloth, or other suitable permeable material, and which is fitted with suitably arranged and contrived blades or scrapers which prevent the concretion of the solid matter on the sides of the cage. A brush or brushes, made to revolve or reciprocate with the motion of the cage, keep the meshes of the gauze of which it is composed clear of solid matter.

Improvements in obtaining acetic acid. John Steedman, of the firm of Steedman and McAlister, manufacturing chemists, Glasgow, Lanark, N.B. October 11, 1872.—No. 3003. This invention consists in passing the vapour of the impure acid as obtained by processes heretofore in use through a hydrocarbon, or through an oil or fat; such hydrocarbon, oil, or fat being maintained at a temperature at least equal to that of the acetic acid vapour, and sufficient to liquefy it.

Improvements in the treatment of coal-gas tars, for the purpose of obtaining certain useful products therefrom. Charles Lowe, manufacturing chemist, Reddish, Lancaster. October 11, 1872.—No. 3005. This invention relates to obtaining carbolic, cresylic, and other acids from London coal-tar, or similar substances.

Improvements in the separation of substances and products capable of being employed for the purposes of dyeing and printing. Edward Chambers Nicholson, Herne Hill, Surrey. October 11, 1872.—No. 3007. This invention relates to the separation of what is known as rosaniline base from other products and compounds, which are either formed during its formation or subsequently in effecting its liberation. Rosaniline base is obtained, as is well understood, by firstly heating together aniline, videlicit, what is known as commercial aniline, with a solution of arsenic acid, in such a manner as is described in the Provisional Protection granted to me, No. 184, and dated January 25, 1860, or otherwise, in order that the desired compounds of rosaniline base shall be formed, which, together with arsenious acid and the excess of or the undecomposed arsenic acid and other products, will constitute what is technically known as the "melt." The melt thus or otherwise obtained is dissolved in water and the compounds of the rosaniline base, in solution or otherwise, are decomposed by means of a stronger base, such, for example, as lime, and the liberated base is separated from the insoluble products thus resulting by solution in water heated to the boiling-point under the ordinary or normal pressure; the solution of the rosaniline base is allowed to cool, and the crystals deposited are collected and utilised for the production of dyes or colours, as is well understood. The rosaniline base thus or otherwise separated and obtained is found to possess but a slight solubility in water boiling at the ordinary or normal pressure, consequently a very large proportion of water is required to effect the solution of a small proportion of the base. In practice it being found that 1 lb. of the base is obtained from a solution of about 60 gallons of water. Now my invention consists in effecting the solution of the so-called rosaniline base or magenta base obtained or resulting from the processes hereinbefore mentioned or otherwise obtained in water heated under pressure, whereby a greater solubility of such base is obtained, and consequently the amount of water necessary for effecting the solution of a given quantity of such base is very much diminished. In carrying out this invention I take the melted mass resulting from the foregoing or other similar processes and reduce that which is technically known as the "melt" to a rough powder by means of edge rollers or otherwise, and I mix the same, either during such process of grinding or subsequently, with caustic lime, either hydrated or otherwise, and in such quantity as shall suffice to neutralise any acid and liberate the rosaniline or magenta base. Such mixture or product I then transfer together with water into a suitable apparatus or boiler capable of withstanding an elevated pressure, to which I apply heat. The desired solution having been obtained by reason of the elevation of the pressure and consequent increase of temperature. The solution or the contents of the boiler may be transferred, either before or after subsidence, to another vessel, wherein the separation of the rosaniline and magenta base thus extracted may be effected. Should the rosaniline or magenta base not be fully extracted by the first treament by means of water heated under pressure the treatment may be repeated.

Improvements in the method of and apparatus for separating the soluble constituents of substances from the insoluble constituents. Samuel Henry Johnson, F.C.S., chemist, Lea Bank Works, Stratford, Essex. October 12, 1872.—No. 3014. According to this provisional specification the material to be operated on is placed in a suitable vessel, and the solvent is forced upwards through it entering near the bottom and being drawn off near the top. The spent material is then forced out by a plunger through a tubular passage; the compressed material in this passage plugs it and prevents the solvent passing.

NOTES AND QUERIES.

Zinc Powder.—Can you tell me where I can get, or how make "finely-granulated zinc" (as fine, or finer, than Calais sand)?—R. A. R.

Deodorising Naphtha.—Would you be kind enough to state in your next issue if there is any method of removing the smell from naphtha, or torch-oil, without losing any of its illuminating powers or burning properties?—PETER TRUMBLE.

Crystallising Pan for Nitrate of Lead.—Can you inform me what is the best kind of vessel for evaporating a solution of nitrate of lead, in a large quantity, for the purpose of crystallising; and whether the heat of steam, or of fire, direct, is the best for this purpose?—CONSTANT SUBSCRIBER.

"Experiments with the Torsion-Rod for Determining the Mean Density of the Earth," forming vol. xiv. of the *Memoirs of the Royal Astronomical Society*. By Francis Baily, Esq., Vice-President of the Society. London. 1843.

P. 7 (referring to Cavendish's experiment).—"Yet, notwithstanding the precautions which he had taken, he still met with some anomalies for which he could not satisfactorily account, and which appear to have affected the results rather more than he had anticipated."

See p. 10 for good description of the room.

See pp. 23-24 for description of the scale and telescope. A good plan.

P. 26.—"The 2 inch and the 2½ inch lead balls were gilt and burnished, in order to prevent any radiation of heat from the surface."

P. 31.—" . . . if the slightest change of temperature be applied near the side of the torsion-box, or if either *side* near the balls be sprinkled with a little spirit of wine, the torsion-rod is immediately put in motion, and the resting-point undergoes a rapid change."

P. 35.—" . . . the mean increase of temperature has been only 0·15° F. per hour. Now, when it is considered that I am always obliged to remain in the room during the whole time of any experiments, and that a lamp is occasionally necessary for observing the microscopes, this change of temperature is of no great amount; nor, indeed, does it produce any anomalous effect on the motion of the torsion-rod. For I have generally noticed that anomalies arising from this source seldom occur except when *sudden* changes of temperature are produced in the torsion-box; and then only when one side of the torsion-box is more affected than the other, which seldom occurs in the ordinary state of the atmosphere."

P. 36.—"Both of these experimentalists" (Cavendish and Reich), "in the pursuit of their enquiries, met with anomalies for which they could not satisfactorily account; and although Cavendish suspected the cause of some of these anomalies, and even undertook a few experiments for the express purpose of discovering it, yet he does not appear, either then or at any future time, to have pursued the subject further, nor to have applied any remedy for the evil in any of his subsequent experiments. He closes the account of his thermometrical experiments with the following laconic remark:—'It seems sufficiently proved, therefore, that the effect in question is produced by the difference of temperature between the weights and the case.' He probably considered that the amount of the disturbing force, although very sensible when tried in the extreme cases which he pursued, yet under the ordinary circumstances of temperature was too minute to lead to

any material error in the results, and therefore abandoned the attempt to remove it; for he says, 'It, indeed, may be objected that, as the result appears . . . . (for this quotation see Cavendish's original paper, CHEMICAL NEWS, vol. xxvii., p. 210) . . . . 1-14th of the whole.' Had Cavendish, however, increased the number of his experiments, he would soon have discovered the error of his opinion, and that it would be absolutely necessary to remove altogether, or at least to modify, this disturbing force before he could place any dependence on the result of his labours."

P. 37.—"Although Reich pursued his experiments in a room which was rather more favourably situate than the outhouse of Cavendish, yet it appears that this distinguished experimentalist also experienced anomalies for which he has not given any satisfactory explanation. Indeed, he does not describe the nature of those anomalies. . . . . But at the end of his work . . . he subjoins the following passage, which bears upon the . . point in question, to which I am desirous of drawing the attention of the reader:—'Totally different from these gradually progressive changes in the times of vibration, and also easily to be distinguished therefrom, were the *still much greater anomalies* that were *occasionally* observed, and which were produced by a small obstruction that was opposed to the vibrating arm. It is probable that small hairs or filaments caused by foulness had introduced themselves into the narrow case, and which immediately produced much shorter periods of vibration, greater irregularities in them, and a rapid decrease of the arc of vibration. *Whenever* this happened, the case was carefully cleaned: that is to say, all the filaments that were in the narrow tube through which the wire that supported the balls passed, were destroyed by means of a burning flame passed through it.' Now, it is difficult to understand how these *occasional* interruptions could have taken place at such short intervals, after the tube had been once properly cleaned and closed; and as no other allusion to such disturbances has been made in the account of the experiments that appear in the book, not only a doubt naturally arises as to the nature and magnitude of the anomalies, and the precise manner in which the results were affected, but a suspicion also is entertained that some of the experiments thus alluded to may have been rejected, on account of their presumed discordance."

MEETINGS FOR THE WEEK.

MONDAY, 12th.—Geographical, 8.30.
— London Institution, 4.
TUESDAY, 13th.—Royal Institution, 3. J. H. Parker, "On Roman History and Architecture."
— Civil Engineers, 8.
— Photographic, 8.
WEDNESDAY, 14th.—Society of Arts, 8.
— Geological, 8.
THURSDAY, 15th.—Royal Institution, 3. Prof. Tyndall, "On Light."
— Chemical, 8. Dr. H. E. Armstrong, "On Isomerism."
— Royal, 8.30.
— Royal Society Club, 6.

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THE CHEMICAL NEWS.

VOL. XXVII. No. 703.

A DISCOURSE ON ALCOHOLS FROM FLINT AND QUARTZ.*

By Professor EMERSON REYNOLDS, M.D.

IN appearing before you this evening to lecture on "Alcohols from Flint and Quartz," you will permit me at the outset to explain, and even materially to extend, the title of my discourse.

I do not propose to show that spirits can be extracted from flint and quartz by mechanical processes; but I hope to satisfy you that by indirect and purely chemical means we can obtain from these familiar and widely-diffused minerals, and from native silicates, bodies resembling in chemical action, and even in appearance, the well-known alcohol of wine.

Carbon has hitherto been considered the sole alcohol-forming element; but we shall see that the chief constituent of flint and quartz, namely, silicon, must now be admitted to share in this power, and likewise in the ability to form other remarkable compounds that it will be necessary for me to refer to in the course of this lecture.

In selecting this subject, I have done so in part because this most promising field of research, opened up by the labours of Wöhler, Buff, Friedel, Crafts, Ladenburg, and others, has hitherto been but little cultivated in this country, and therefore probably possesses some novelty for the audience I have the honour to address; and also because we find in this new branch of chemical investigation most interesting illustrations of the advantage we may derive from the cautious use of the argument from analogy.

As a preliminary to the enquiry I propose, we may consider very briefly the chemical nature of flint and quartz.

The word "flint" is of very ancient origin, and was often used to indicate any particularly hard rock. In this sense it is employed several times in the Old Testament—first, in the book of Deuteronomy, viii., 15, and in Psalms, cxiv., 8, where the rock struck by Moses is said to be "of flint." We now use the term to distinguish a well-known uncrystalline mineral, which can be easily shown to be a chemical compound of two so-called elementary forms of matter—oxygen and silicon.

Flint is identical in chemical composition with quartz or rock-crystal, though physically different, as you will perceive by reference to the fine specimens on the table, kindly lent by Mr. Bryce M. Wright, the well-known mineral collector. The common name of "silica" is given to the chemical compound, and the terms flint, agate, quartz, rock-crystal, are reserved for the forms in which we meet with this remarkable substance in nature.

Having cleared our ground so far, we have to find how the oxygen may be separated from any of those forms of silica, and the element silicon may be obtained. This cannot be directly accomplished, but by indirect means we can obtain the desired results. I have here a quantity of finely-divided flint mixed with some powdered fluor-spar; when I pour oil of vitriol on the mixture, and apply heat, a colourless gas is obtained, which, when passed into water, produces a highly acid and gelatinous liquid. The gas is a compound of the element fluorine, with silicon—the tetrafluoride of silicon—and this, when brought in contact with water, produces an acid called hydrofluosilicic and a quantity of gelatinous hydrate of silica.

The clear acid liquid, when treated with caustic soda, yields this white salt, the fluosilicate of sodium, from which we directly obtain the silicon, as you see, by simply heating with some metallic sodium. In this case, the sodium replaces the silicon, the latter separating, as you observe, in the tube as a dark brown substance.

Having thus prepared silicon from flint, we are in a position to compare it with carbon, to trace out the analogies which subsist between them, and then to show that some of the alcoholic and other *compounds* of carbon have their strange and interesting analogues in a silicon series.

First, then, we shall compare the elements themselves.

We meet with nearly pure carbon under the well-known forms of charcoal, graphite, and diamond.

We can easily prepare the corresponding varieties of silicon—the amorphous, the graphitoidal, and adamantine. With the aid of the phengascope, I shall now project on the screen images of specimens, in order that you may compare the varieties side by side. I have also on the table a very fine specimen of crystallised silicon, for which I have to thank Messrs. Hopkin and Williams. [The lecturer showed a greatly magnified image of a fine crystallised diamond on the screen; a number of other specimens were exhibited in the same way.]

As might be anticipated, the specific gravity of carbon is lowest in charcoal and highest in diamond. Corresponding differences in specific gravity are observed between the varieties of silicon. The two elements also correspond remarkably in variations of specific heat, with different states of aggregation. The specific heat of the diamond is lower than that of graphite, and the specific heat of adamantine silicon is lower than that of the graphitoidal variety.

Passing now from the points of physical resemblance between carbon and silicon, I shall dwell more particularly on the chemical relations of the two elements.

We are familiar with the fact that carbon burns in oxygen, producing, in an excess of that gas, the well-known gaseous oxide of carbon commonly called carbonic acid; charcoal or coke burn readily in oxygen, while graphite is consumed with considerable difficulty, and the diamond is still more difficult of combustion. Amorphous silicon burns as easily in oxygen as charcoal, and forms the oxide silica, the same oxide that we find as flint or quartz. [Experiments exhibited.]

In this way we can reproduce, so far as composition is concerned, the substance from which we originally obtained the silicon for our experiments. Now, though amorphous silicon is easily burnt, the graphitic and adamantine varieties of the element resemble the corresponding forms of carbon in difficult combustibility. Crystalline silicon may be raised even to a white heat in oxygen gas without burning.

Unlike carbon, silicon in any of its forms easily combines directly with chlorine, producing the liquid choride which I have in this tube. This is a very volatile body, boiling at 50° C., and is half as heavy again as water. It can also be prepared from silica by heating to full redness the finely-divided oxide and carbon in a current of chlorine. In composition this chloride is the silicon representative of tetrachloride of carbon.

In addition to this chloride of silicon, the discovery of which we owe to Berzelius, another has very recently been obtained by Friedel, which corresponds to a well-known carbon hexachloride.

We next pass to a compound of silicon with hydrogen It may be prepared in a pure state by means of a rather complex reaction I shall have presently to refer to; but we can easily obtain the impure gas by Wöhler's method, in treating a compound of silicon and magnesium with hydrochloric acid. We thus obtain a colourless, spontaneously inflammable gas, which burns with a bright light on contact with the air. In its pure condition, siliciuretted hydrogen is not spontaneously combustible at ordinary pressure, but in a slightly rarefied atmosphere it easily in flames. The compositions of these silicon and carbon compounds are shown in this table:—

* Delivered before the Royal Institution, May 2, 1873.

SiO_2.	Oxides.	CO_2.
$SiCl_4$.	Chlorides.	CCl_4.
Si_2Cl_6.	,,	C_2Cl_6.
SiH_4.	Hydrides.	CH_4.

The siliciuretted hydrogen is evidently the chemical analogue of marsh-gas, the tetrahydride of carbon.

It is usual to regard marsh-gas as the typical carbon compound from which some alcoholic series may be supposed to spring, and, in fact, all the alcohols belonging to the group of which the well-known wood-spirit and spirit of wine are the chief members, are commonly regarded as derivatives of marsh-gas, in which a part, or all, the hydrogen has been replaced by one or more compound radicals, such as hydroxyl, methyl, ethyl, propyl, &c. In these cases, the carbon of the marsh-gas is the grouping element of the compound, or that constituent which serves to bind together the different materials of which the molecular edifice is constructed. In the same way, the silicon in siliciuretted hydrogen may be shown to be the nucleus round which can be grouped hydroxyl, methyl, ethyl, &c., so as to form the alcohols whose compositions I shall presently have to refer to. Several of the less complex terms are still wanting, but their existence is rendered highly probable by the occurrence of bodies bearing the same close relation to the unknown alcohol that marsh-gas bears to wood-spirit, or the acid of vinegar (acetic acid) to common spirit of wine. As we ascend in the series, however, we meet with the true alcohols, in which silicon takes the place of carbon as the grouping element.

It must be here admitted, however, that no well-defined alcohols have yet been discovered in which silicon acts in any other way than as the nucleus of the compound; carbon radicals in all these cases playing the subordinate parts. But we have every reason to expect that complex alcohols containing silicon only will yet be obtained as researches extend.

In 1857 Buff and Wöhler obtained a volatile fuming liquid on heating crystalline silicon nearly to redness in a current of dry hydrochloric acid gas. The precise nature of this liquid was unknown until 1871, when Friedel and Crafts published the results of their admirable researches upon Buff and Wöhler's liquid, and showed that it was a mixture of chloride of silicon with a new body, which proved to be the strict chemical analogue of our well-known chloroform, silicon replacing carbon.

$SiHCl_3$. Chloroform. $CHCl_3$.

This body is a colourless, mobile, and very volatile liquid boiling at 35° C. I have a quantity of it in this tube. One of its most remarkable properties is that of exploding with great facility when its vapour is mixed with air. I shall now show you the experiment. Ordinary chloride of silicon does not afford an explosive mixture when its vapour is mingled with air. [Experiments shown.]

When this remarkable body is made to unite with anhydrous alcohol, a colourless ethereal liquid is obtained on distillation, having an agreeable odour, and a boiling-point at 134° C. This body is strictly analogous in composition to a substance obtained by Williamson and Kay, by acting on ordinary chloroform with sodium alcohol.

These ethers may each be regarded as derived from a glycerine or triatomic alcohol, as shown below. Neither of these alcohols have as yet been isolated.

$Si\{H, OC_2H_5, OC_2H_5, OC_2H_5$	Formic ethers (tribasic).	$C\{H, OC_2H_5, OC_2H_5, OC_2H_5$
$Si\{H, OH, OH, OH$	Glycerins.	$C\{H, OH, OH, OH$

By the action of sodium on the silicon ether just referred to we can obtain siliciuretted hydrogen in a state of purity. This is the only known mode of obtaining the pure compound.

Returning to the silicon chloroform, about whose chemical nature we can now have little if any doubt, we next have to enquire in what direction, and how far, we can pursue the analogy between the great pain-killer, discovered almost simultaneously by Soubeiran and the illustrious chemist of Giessen, who has so recently passed away from amongst us, and the curious body that we can obtain indirectly from flint or other form of silica in the manner I have described.

Ordinary chloroform is well known to be closely allied to common wood-spirit, or methyl alcohol, in a way that will be evident on comparing the formulæ. In fact, chloroform is easily obtained by treating wood-spirit with bleaching-powder. We cannot in any simple way reverse this process and prepare wood-spirit from chloroform, but we can do something in this direction, for we are able by the action of caustic potash to obtain from chloroform formic acid, a body which is one of the most remarkable products of oxidation of wood-spirit. The relation of formic acid to the alcohol is shown in the table below; and it is there further pointed out that this formic acid should yield an anhydride—a body capable of producing the acid by union with the elements of water. This anhydride is not known, but the importance of suggesting its existence will appear in a moment.

$Si\{H, H, H, OH$	Methyl alcohols.	$C\{H, H, H, OH$
$Si\{H, O, OH$	Formic acids.	$C\{H, O, OH$
$Si\{H, O, O.SiOH)$	Anhydrides.	$C\{H, O, O(COH)$

Regarding silicon-chloroform from the same point of view, analogy would lead us to look for a simple silicon alcohol similar to wood-spirit or methyl alcohol; but we would not expect the silicon-chloroform easily to yield this alcohol directly, though we would be justified in hoping that an acid corresponding to formic acid might be obtained. As a matter of fact, no such alcohol has as yet been prepared even indirectly; but a corresponding acid is very readily produced, and more than this, for the anhydride at present wanting in the carbon series is found in that of silicon. If I pass the vapour of silicon-chloroform into water nearly ice-cold, a white solid body is obtained without any evolution of hydrogen, and an acid liquid produced. The white solid then collected, washed, and dried at a low temperature, forms a white inflammable powder, which was first described by Buff and Wöhler. Friedel and Ladenburg have shown that this remarkable body is the anhydride of the silico-formic acid. According to the results of my own investigations, the acid liquid to which I referred just now contains, in addition to hydrochloric acid, the true silico-formic acid—a body possessing nearly as energetic reducing properties as the corresponding acid derived from wood-spirit. I shall now demonstrate these facts. [The lecturer then exhibited the experiments referred to.]

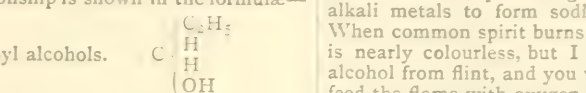
It will naturally be asked whether the silicon chloroform is capable of acting as an anæsthetic like ordinary chloroform. But it is only necessary to bear in mind the fact that it is very easily decomposed by water into gelatinous matter, and highly corrosive hydrochloric acid, in order to understand that its inhalation would be attended by the speedy destruction of the lungs of any person persisting in the experiment.

Starting from silicon chloroform, then, we have been led, by analogical reasoning in the first instance, to infer the existence of a simple silicon alcohol precisely corresponding to wood-spirit. On testing this induction by experiment, we have obtained answers which are, so far as they go, altogether favourable to the view just stated.

In fact, the results are as satisfactory as they can be short of the discovery of the silico-methyl alcohol.

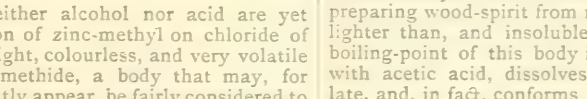
I shall now endeavour to strengthen this position by showing that the existence of three higher members of the alcoholic series has been rendered highly probable by the discovery of closely related bodies, though the alcohols themselves have not been isolated; and, finally, I shall show that the alcohols of still higher terms have actually been obtained.

In the course of their elaborate and able investigation of silicon compounds, Friedel and Crafts discovered that chloride of silicon easily acts upon common alcohol as I have already mentioned, producing a body which Friedel and Ladenburg have recently shown to be easily attacked by a mixture of sodium with a curious substance contained in this tube—zinc-ethyl. The product, when treated with caustic potash, yields a body which bears the same relation to silico-propyl alcohol that formic acid does to wood-spirit. This relationship is shown in the formulæ—



This silico-propionic acid is in this tube, and is a white combustible powder, like the silico-formic anhydride I have already shown to you. It is soluble in warm caustic potash, but not in caustic soda; by which character it can be distinguished from silica. It is only necessary to state that it can be obtained in aqueous solution, and in the pure state, by Professor Graham's valuable dialytic process.

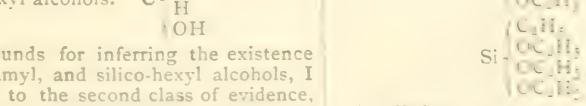
In the amyl term, neither alcohol nor acid are yet known; but by the action of zinc-methyl on chloride of silicon we can obtain a light, colourless, and very volatile liquid, which is silicon-methide, a body that may, for reasons which will presently appear, be fairly considered to stand in the same relation to silico-amyl alcohol that marsh-gas does to wood-spirit. Thus—



The researches of Friedel and Crafts have made us acquainted with a body which may also probably be regarded as the hydride corresponding to silico-hexyl alcohol. This compound is prepared by the action of zinc-methide and zinc-ethide in chloride of silicon.

Having, therefore, grounds for inferring the existence of silico-propyl, silico-amyl, and silico-hexyl alcohols, I shall now pass at once to the second class of evidence, and show that the alcohols of still higher terms can actually be prepared.

In referring to the preparation of silico-propionic acid, it was stated that when chloride of silicon acts upon absolute alcohol a body is obtained which, on treatment with zinc-ethyl and sodium, yields an ethereal product from which silico-propionic acid can be obtained by treatment with caustic potash. If, however, instead of using the caustic alkali we continue the action of zinc-ethyl and sodium, decompose the products with water in sealed tubes, and distil, a liquid is obtained which contains one of the "alcohols from flint" we are in search of. In this tube I have a small quantity of the alcohol, and here you will find its composition stated—



You will observe that it is the silico-heptyl alcohol precisely corresponding to a simple carbon alcohol recently discovered by Nahapetian, both being *tertiary* alcohols. We owe to Ladenburg the discovery of this lowest known term of alcohols containing silicon. As you can observe it is a colourless liquid, not unlike the ordinary alcohol of wine. It is insoluble in water, but easily dissolved by spirit and ether. Chemically it acts just like any of the other alcohols, producing ethers, and dissolving the alkali metals to form sodium or potassium alcoholates. When common spirit burns you are aware that its flame is nearly colourless, but I shall now burn some of our alcohol from flint, and you will find, particularly when we feed the flame with oxygen, that a bright light is emitted.

Clearly defined though this alcohol is, it does not stand alone, for at least one other compound of the same order is known. It was suggested in 1870, by Friedel and Crafts, that silicon ethide—a body easily prepared by the action of chloride of silicon on zinc ethide—might be regarded as the hydride of silico-nonyl, and should stand in the same relation to an alcohol that marsh-gas does to common wood-spirit, or ethyl hydride to ordinary alcohol. This happy idea, when put to the test of experiment, was fully justified by the result, for, on treating silicon ethide in essentially the same manner that we should adopt in preparing wood-spirit from marsh-gas, a colourless liquid, lighter than, and insoluble in, water is obtained. The boiling-point of this body is 190° C. It yields an ether with acetic acid, dissolves sodium, forming an alcoholate, and, in fact, conforms to the general habits of the alcohols of the series to which common spirit belongs. The compositions of these bodies are thus represented—

It is thus shown to be precisely similar to the nonyl alcohol prepared by Pelouze and Cahours from American petroleum.

Ladenburg has very recently advanced even beyond the point we have now reached, and has shown that the chloride of silicon can be made to yield two ethers, which correspond, as I may suggest, to silico-nonyl diatomic and triatomic alcohols. Thus—

In all the preceding compounds it will have been noted that but one atom of silicon is present, and though, as I pointed out in the earlier part of this lecture, the silicon in these cases occupies the chief position as the grouping element, we should much like to see silicon uniting with silicon, and forming a more condensed compound with hydrogen. Happily, however, very important evidence, even upon this point, is forthcoming, for Friedel and Ladenburg have discovered corresponding hexa-chloride,

iodide, and bromide of silicon, and treatment of the hexa-iodide with zinc-ethyl enables us to obtain the ethide whose formula is given in this table—

Hydride.	Chloride.	Ethide.
$Si_2 H_6$	$Si_2 Cl_6$	$Si_2 (C_2H_5)_6$

It is not improbable that in the last-named compound we have the starting-point of a new series of still more complex bodies, analogous to derivatives of olefiant-gas rather than to those of marsh-gas.

I trust you will now admit that the case I proposed to lay before you has been made out—namely, that we can obtain some alcohols indirectly from flint or other form of silica, and that we have solid ground for inferring the existence of many others.

A rich and beautiful field for chemical research appears to lie before us in tracing out the analogies between the compounds of carbon and silicon, and recognising the chemical representatives of many of the most complex "organic compounds" in the native silicates which form so large a part of the crust of this earth.

Hitherto in this lecture I have avoided reference to subjects not directly connected with the matter in hand, but, before concluding, I would refer, necessarily in a very few words, to some enquiries in this department of chemistry which have been carried on in the laboratory of the Royal Dublin Society. First, however, allow me to perform an experiment. I have here a glass jar filled with dry ammoniacal gas; when I drop into it some chloride of silicon, a white compound is obtained. This body was discovered by Persoz in 1830, and the composition he assigns to it would, as ably suggested by Dr. Hofmann, represent a mixture of sal-ammoniac with the hydrochlorate of silicon-guanidine. If this white body be ignited strongly in a closed vessel, an infusible white substance remains, which has been examined by Deville and Wöhler, who have shown that it contains silicon and nitrogen, and that the same or similar body can be produced by intensely heating crystalline silicon in an atmosphere of nitrogen.

My examination of this curious body has led me to the conclusion that it is the silicon analogue of cyanogen—a well-known compound of nitrogen with carbon, and the chief constituent of the deadly poison prussic acid. This body, though little affected even at a very high temperature, in the absence of moisture is easily decomposed by steam—silica, ammonia, and hydrogen resulting. A similar decomposition is effected by heating with soda-lime. I may add that, when this singular compound is fused with a small quantity of carbonate of potassium, cyanide and silicate of the metal are produced; in this case, carbon appears to displace silicon.

If, in the experiments with ammoniacal gas, we substitute silicon-chloroform for the silicic chloride, a body is obtained from which this compound of silicon and nitrogen can be easily extracted. Now we know well that when ordinary chloroform is heated with ammonia gas, chloride and cyanide of ammonium are obtained, and that under certain circumstances a body called *paracyanogen* is also produced. Analogy would lead us to anticipate that silicon-chloroform would react in a similar manner, and the facts I have hitherto observed justify this inference.

It would be out of place to pursue this subject here, as the results of the enquiry referred to have not yet been published. I have, therefore, now simply shown to you one of the chief bodies to which interest belongs, and ventured to point out the relationship I believe it to bear to some of the well-known and remarkable compounds of carbon with nitrogen.

In concluding this lecture, I need simply remind the audience I have the honour to address that the practical value of scientific research is rarely apparent at first. Who could have suspected that the benzole discovered by the venerable philosopher whose name is so inseparably connected with this Institution, would have proved, in the able hands of Perkin and of Hofmann, the chief source of many of the exquisite dyes now largely manufactured in this country? Yet in this, as in a hundred of other instances, the small and apparently useless scientific seedling has gradually expanded into the strong tree, yielding its rich store of useful fruit. Let us hope that a similar future awaits some of the alcohols from flint which have been referred to this evening, and that, in pursuing our studies of the silicon analogues of the more complex carbon compounds, we may be led to appreciate more fully than we have hitherto done the admirable economy and harmony of Nature.

UTILISATION OF SEWAGE.*

The author of this pamphlet was commissioned by the Prussian Minister of Agriculture to pay an official visit to England, in order to inspect and report on the various systems of dealing with sewage. The result of his investigations may be fairly considered as one of the most instructive works ever written on this important question. Looking at facts with the eye of an unprejudiced observer, he tells us truths which may be unpalatable to certain enthusiasts.

In speaking of the Lodge Irrigation Farm, near Barking, he shows that the apparent profit of £1324 is in reality a loss of £157! "As far as I have observed," says the author, "almost all calculations upon the profits of sewage-irrigation farms in England have been drawn up in the same manner. Mr. Samuelson, M.P. for Banbury, with whom I had a very detailed conversation on the sewage question, informed me that he did not believe in the profitable working of a single sewage farm in England, notwithstanding all calculations as to apparent gain." He also quotes the following significant passage from the Birmingham report:—"It would be utterly irrational to expect anything but loss, even though the sewage itself may possess considerable manurial value."

In Banbury, again, M. Lefeldt finds an imaginary gain of £59 12s. 10d., which on close examination turns out to be a loss of £466, without any charge for the sewage.

The account of the Edinburgh irrigation meadows contains a most important fact: if the sewage-water is allowed to flow upon the land until two days before mowing, the growth is found most luxuriant, with the single drawback that cattle refuse to eat the grass. "The capillary tubes for some inches above the roots are found to be filled with unassimilated fœcal matters." Is it not, then, perfectly possible that the vegetables from irrigation farms may be contaminated in like manner? Man, at least in a state of civilisation, does not possess the instincts which warn cattle against such dangerous food. Is it prudent to uphold a system of agriculture which may thus introduce the germs of zymotic disease and the ova of entozoa into the human frame? "The city," says the author, "derives no pecuniary advantage from irrigation, and the authorities, as far back as 1839, proposed the abolition of the system, as the emanations from the land were by some persons considered unwholesome.

At Carlisle, where the sewage is disinfected with carbolic acid previous to being used for irrigation, the author met with no complaints of offensive effluvia, and hence he recommends some such previous treatment as very desirable.

Concerning the emanations of irrigation farms where no previous treatment is applied to the sewage, we find it

* "Der Gegenwaertige Stand der Abfuhr und Kanalisationsfrage in Grossbritannien. Berichte au Se. Excellenz, den Kgl. Preuss. Minister fuer die Landwithschaftlichen Angelegenteiten Erstattet," von W. Lefeldt, Civil Ingenieur in Schœningen. Berlin: Wiegandt and Hempel. 1872.

recorded that—"The landlord of the Peto Arms, near Barking Station, Mr. Jesse Bailey, declared that at times, especially on warm summer days when the wind blew direct from the Lodge Farm, the fumes were very unpleasant, although the distance is nearly a mile." Again—"The deposits of the notorious settling-tanks, and their entire vicinity, diffused truly *mephitic* odours. Even on the celebrated Breton Farm (Mr. Hope's) I experienced this, on my second visit, in the most horrible sense of the word."

The author considers that, where irrigation is adopted, an acre of land should be arranged to receive the secretions of every twenty to thirty-five persons. On this scale Birmingham would require a sewage farm of from 10,000 (Mr. Hope's estimate) to 13,000 acres, whilst London would require a snug little plot of some 150,000 to 200,000 acres. Well may M. Lefeldt exclaim—"That for large cities a vast tract of land, and a gigantic capital for purchase, preparation, and management, would be requisite, is so self-evident as scarcely to require mention." He adds—"The difficulty of irrigation lies here, that the purification and the economical application of the sewage must go hand in hand. Purification *alone*, with a total disregard of expense, is quite practicable; economic utilisation alone is also attainable in favourable cases. But the irrigation farmer is compelled to take and to purify the sewage when he can make no use of it—in rainy weather and in winter."

Such is the light in which sewage appears in the eyes of a disinterested and intelligent stranger. Surely we ought to pause before giving so unsatisfactory a system legal sanction.

ON THE

SPECTRA OF SOME COBALT COMPOUNDS IN BLOWPIPE CHEMISTRY.

By CHARLES HORNER.

IT is well known that certain substances may be identified by the different colours they exhibit after the application of cobalt solution, or cobalt oxide, with the aid of heat; and having lately studied many of these compounds by means of the micro-spectroscope, I find the spectra vary sufficiently, in a few instances, affording not only additional evidence of the substance under examination, but also enabling us to form an opinion, in some cases, quantitatively.

In reference to the spectroscope, I may say that one of *low* dispersive power is essential for seeing distinctly the bands due to these compounds; and since the accurate position of the absorption bands had to be determined, I had recourse to the micro-spectroscope, which enabled me to measure them with precision, although a small hand spectroscope, like Mr. Browning's "Miniature" instrument, is very convenient, especially for examining the spectra of hot beads. Mr. Sorby's interference-plate was used as a scale of reference, whilst Mr. Browning's bright point micrometer served as an indicator.

Since Capt. Ross has lately proposed boric acid as a valuable flux for estimating the alkalies quantitatively, when combined with cobalt, and since my own experiments lead me to confirm some of his conclusions, I shall therefore begin at once with an account of these results.

When cobalt oxide is added to boric acid, and strongly fused for two or three minutes in the inner flame, using gas as a source of heat, the cold bead possesses a dull blue colour, and is almost opaque. However, by using a powerful light we can see it gives a spectrum of three very faint bands, nearly in the same position as shown in Fig. 2; if, now, 1 per cent of sodium carbonate be taken up, and the bead treated as before, when cold, the colour is a murky reddish-purple, and the spectrum no longer giving the band in the red, but two obscure absorption bands, very close together, and a slight shading at F, as shown in Fig. 1. Upon adding 4 per cent of soda the bead becomes quite clear and paler, showing the same spectrum, but while *hot* showing the band α, as in Fig. 2. A further addition of 10 per cent of sodium carbonate causes the bead to remain a dark purple when *cold*, and exhibiting the complete spectrum of Fig. 2. When 25 per cent has been added a blue bead results, and the spectrum in Fig. 2 changes; the band marked β is perceptibly lowered, overlapping D, as in Fig. 3, but the band γ *remains* as in Fig. 2. If 5 per cent more is taken up, the three absorption bands are like those drawn in Fig. 3, which represents cobalt dissolved in borax. The bead is now very dark, and requires pressing, whilst hot, between the points of the forceps, to render it sufficiently diaphanous. In these experiments it is necessary the amount of cobalt should be known when added to the weighed boric acid bead, since the determination of the alkali is affected by the quantity of oxide present; *e.g.*, if enough cobalt has not been dissolved, it may require 17½ per cent of sodium carbonate to render the band visible in the red of Fig. 2.

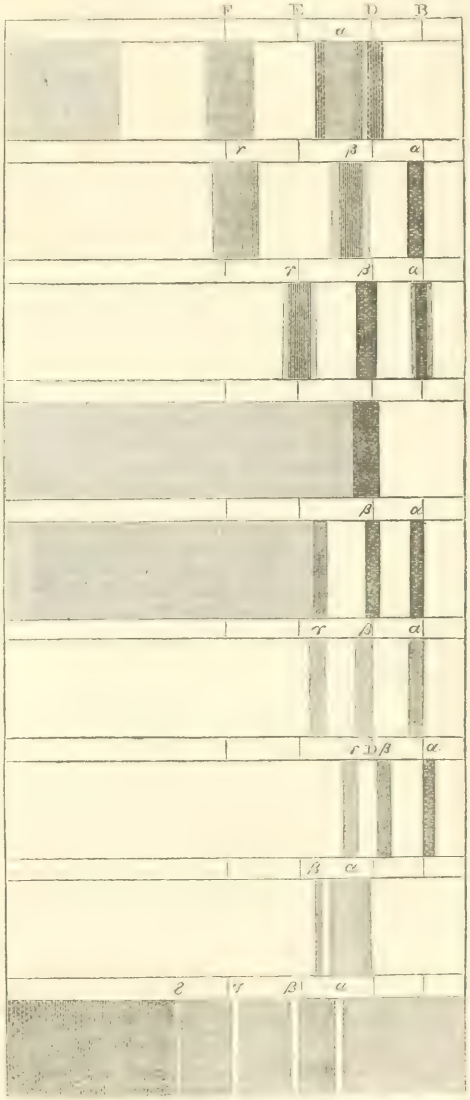


FIG. 1.
FIG. 2.
FIG. 3.
FIG. 4.
FIG. 5.
FIG. 6.
FIG. 7.
FIG. 8.
FIG. 9.

I have not hitherto tried potash or lithia by the same method, but probably they would furnish equally interesting results.

Fig. 4 represents the spectrum of a salt of magnesia when moistened with solution of cobalt. It is a single band, with a good deal of shading in the green and blue.

Fig. 5 is the spectrum of the indigo-blue compound of calcium oxide when treated with cobalt. The application of the blowpipe flame is not requisite to fulfil this reaction, the colour appearing the same instant the solution is applied. Its spectrum shows the two bands very distinctly, especially the one in the red, and there is some shading in the green.

Fig. 6 is the interesting spectrum of the bright blue compound of alumina. These three bands, although generally faint, are narrow and well defined, the blue and green spaces being invariably clear. Websterite and cryolite show this spectrum to great advantage. With regard to silica, I have not, as yet, been able to form a compound giving a characteristic spectrum to be available as a means of detection in small quantities. Pure silica, as pointed out by Capt. Ross, turns purple when acted on by cobalt. This gives a spectrum very similar to the alumina compound, except in regard to the band in the green, which is not nearly so well defined. But in mixtures, as in minerals, this reaction is of no use. Sodium carbonate dissolves silica until there results a clear bead; when cobalt is added it assumes a deep indigo, and gives a spectrum of three sharply-defined dark bands, somewhat resembling those in the borax compound, only the band in the green being more refrangible, and therefore the most characteristic. The beautiful green compound of oxide of zinc which is occasionally used as a pigment, and known as Rinman's green, gives the spectrum pourtrayed in Fig. 7.

The last compound to which I shall now draw attention is sodium carbonate and boric acid. When a thin soda bead is formed with a mere fragment of boric acid, and fused along with a little cobalt, in the outer flame, the bead while hot is of a deep orange-brown colour, turning nearly black and opaque on cooling, but before becoming quite cold rapidly crystallises and turns green. By transmitted light the whole of the blue is cut off and part of the red, while a narrow band is visible at the yellow end of the green. If the bead, however, be submitted to the action of the inner flame, it turns a pale blue while hot, and crystallises on cooling to a pale pink by transmitted light, and assuming a lavender tint by reflected light. This unique spectrum of the pink bead is depicted in Fig. 8; and fig. 9 represents the flame spectrum of boric acid, consisting of four bright bands.

The following are the numerical values of the several absorption bands, according to Mr. Sorby's ingenious method of notation (*Proc. R. S.*, vol. xv., p. 434):—

Fig. 1 .. .. $\alpha = \dot{4}\frac{1}{2}, \beta = \dot{3}\frac{3}{4}$

Fig. 2 .. .. $\alpha = 2, \beta = \dot{4}\frac{1}{2}$

Fig. 3 .. .. $\alpha = \bar{1}\frac{3}{4}, \beta = \bar{3}\frac{3}{4}, \gamma = \ddot{5}\frac{1}{4}$

Fig. 4 .. .. $\alpha = \ddot{3}\frac{1}{2}$

Fig. 5 .. .. $\alpha = \bar{2}, \beta = \ddot{3}\frac{1}{2}, 4\frac{1}{4} \ldots\ldots$

Fig. 6 .. .. $\alpha = \dot{2}, \beta = \dot{3}\frac{3}{4}, \gamma = \dot{5}\frac{3}{4}$

Fig. 7 .. .. $\alpha = \bar{1}\frac{1}{2}, \beta = \dot{3}, \gamma = \dot{4}\frac{1}{2}$

Fig. 8 .. .. $\alpha = \ddot{4}\frac{1}{4}, \beta = \ddot{5}\frac{3}{4}$

Fig. 9 measured by the bright point micrometer Na = 1·64°
$\alpha = 2{\cdot}25°, \beta = 2{\cdot}80°, \gamma = 3{\cdot}35°, \delta = 3{\cdot}89°$.

OBITUARY.

JAMES WALLACE YOUNG.

James Wallace Young, aged 30, died at Portobello, on the 12th inst. He was an ardent student of Chemistry of great promise, and was a not infrequent contributor to these pages. His researches were mostly in the field of Chemical Geology, and his papers were always marked by close reasoning and his analyses by minute accuracy. Of a disposition the most kindly and modest, his only earthly ambition was to be a good chemist and microscopist. How far he succeeded in both of these objects is shown by many careful analyses published in these pages, while his enthusiasm as a microscopist is shown in the fine collection of rock sections which he had for years been engaged preparing during his spare hours.

CORRESPONDENCE.

DETERMINING FAT IN MILK.

To the Editor of the Chemical News.

Sir,—In a letter which I wrote to you by last mail, I mentioned the difficulty I had lately met with in determining the weight of the fat in milk. A borate mis-called ether, but consisting really of a mixture of water, alcohol, and ether, was the cause of the failure. I had every reason to suppose the ether good, and in a cold climate the defect would at once have proclaimed itself, but, working as I am at 90° to 92° F., a very little ether suffices to give a strong ethereal smell to a very poor mixture.

Below I send you a description of the method I have lately used for the estimation of fat in milk. I dont know if it is a new one, anyhow I find it a very ready and successful one.—I am, &c.,

F. N. Macnamara.

Medical College, Calcutta,
April 4, 1873.

Take a tube of about 50 c.c. capacity, and, having drawn out one end, introduce 10 c.c. of milk and an equal quantity of alcohol and of ether. Seal the tube, and keep it for two hours in a water-bath at a temperature of 180° F. Allow the tube to cool; break off one end, and allow the fluid part of the contents to drain into a small flask. Exhaust the remaining contents of the tube into boiling ether, and add the washings to the contents of the flask. Let the contents of the flask evaporate till about 10 c.c. of fluid remain; then, when the flask is cool, add ether, and separate, by means of a separating tube, the ethereal solution of fat from the watery fluid. Let the ethereal solution evaporate to dryness in a very small weighed beaker, heat to 212° in a water oven for two hours, and, when cool, weigh. Finally, test the residue as to its solubility in ether before calculating out the result.—F. N. M.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, April 28, 1873.

Manufacture of Sulphate of Ammonia from Nitrogenous Refuse.—L. L'Hote.—The refuse is treated with a dilute solution of caustic soda, either in the cold or at a very gentle heat. A solution or disagregation of the matter is thus obtained. The viscid liquid thus obtained is made into a paste with slaked lime, and the mass is then introduced into a cast-iron retort communicating with receivers containing chamber acid. It is distilled at

the lowest possible temperature to avoid decomposition of the ammonia. When all liberation of gas has ceased the retort is raised to redness. When the operation is complete, a white powder remains in the retort, composed exclusively (?) of carbonate of soda and quick-lime, which, on treatment with water, reproduces caustic soda to serve for a new operation. The sulphate of ammonia thus obtained is coloured, but may be purified by re-crystallisation. If care is taken to operate on a homogeneous mixture of refuse and of alkalies, the whole of the organic nitrogen is recovered as ammonia.

Conditions under which Super-Silicated Cast-Metal is Produced in Blast-Furnaces. — Samson Jordan.—Managers of blast-furnaces, especially such as have had to produce cast-metal destined for the Bessemer process, have been called on to study the conditions under which the so-called "hot" cast-iron is produced, containing silicon to the extent of 1½ to 2½ per cent. Some have even manufactured extra silicated cast-iron containing 7 to 8 per cent. These latter pigs have a quite peculiar aspect. The colour of the recent fracture grows lighter as the proportion of silicon augments; the grain becomes larger, but flat, slightly rounded, without any projecting points or ridges. Its lustre recalls that of pure silicon. The finger in passing over the fracture experiences a sensation quite different from the touch peculiar to pigs rich in graphitic carbon. Thus, in the works which produce these extra silicated cast-irons, they are known under the name of "glazed pig." The following is the analysis of pig-iron of this nature manufactured at Towlaw, near Newcastle:—

Carbon	2·39
Silicon	5·73
Sulphur	0·12
Phosphorus	0·13
Titanium	0·02
Nickel and cobalt	0·04
Manganese	1·33
Iron	90·21
	99·97

The author has studied the production of extra silicated pig-iron at the works at Heerdt, near Dusseldorf. In consequence of an accident to the tubes, which led the air to six tuyeres of the furnace, it was necessary to work during eight days, blowing only through three with a feeble pressure. The temperature of the blast was extremely high, and the charge of minerals was much diminished. The fusible matters in this charge, and which were to form the slag, were in the following proportions:—

Silica	50	Oxygen	26·0
Alumina	16		
Lime	33	Oxygen	17·6
Protoxide of manganese	1		

Proportion of the oxygen of the silica to that of the bases—

$$\frac{26{\cdot}0}{17{\cdot}6}$$

With this charge a viscid slag was obtained, which when once cooled was, like all slags rich in alumina, vitreous and translucid; its colour was an opalescent whitish blue. The melted iron was very liquid, and excessively hot: it flowed in the channel of sand with a homogeneous appearance, without the least bubbling up and without sparks, like melted lead. It filled the moulds exactly without adhering to the sand. When cold it was very brittle, and less sonorous than usual. Its analysis showed:—

Silicon	7·90
Phosphorus	0·72
Carbon	2·60

This is a characteristic "glazed pig-iron." The consumption of coke was 2100 kilos. to 1000 kilos. of metal. In works which employ aluminous minerals, like those of Aveyron which use that of Mondalagac, containing—

Alumina	11·5
Silica	10·0
Lime and magnesia	15·0

highly silicated pigs are ordinarily produced, which waste much in puddling. This production of pig-iron with an aluminous charge is always accompanied with a high consumption of coke. At the St. Louis works near Marseilles, which commonly yield pure grey pig-irons with slags containing—

Silica	33·0
Alumina	15·0
Lime	50·0
Magnesia, manganese, &c.	2·0

the pigs generally contain not more than 1 to 1·5 of silicon. To obtain extra hot Bessemer pigs containing 4 per cent of silicon the charge is modified so as to have—

Silica	40·0
Alumina	19·0
Lime and magnesia	41·0

The conditions for obtaining extra silicated pig-metal are slow working at very high temperature and siliceous, and at the same time highly aluminous, charges. Great heat is required for the alloy of silicon and iron produced, which is more infusible than the common carboniferous cast-iron. The operation must be slow in order that the reduction of silica in presence of carbon and iron may be extensively effected. The proportion of lime must be reduced lest its affinity for silica might interfere with the reduction of the latter, and the alumina is increased to neutralise further the basic action of the lime.

Memoirs on the Actions Produced by Molecular Attraction in Capillary Spaces.—M. Becquerel.—The conclusions arrived at in this memoir are these:—1. Liquid layers adherent in capillary spaces, besides being capable of conducting electricity, have other properties which should be considered in studying electro-chemical phenomena. 2. When certain saturated non-metallic solutions are used, which produce double decompositions in their reciprocal reaction without capillary spaces with formation of insoluble precipitate, this precipitate is not formed in the interior of a capillary space where the walls are of glass (as in a cracked tube); there is a contest between the capillary affinities and the affinities between the two liquids which meet, and the latter are overcome. 3. Finely divided portions of matter, which is insoluble but constantly moist, behave like solid conducting substances on contact with an oxidisable metal, a number of electro-capillary currents are produced, which act like the ordinary voltaic currents. 4. Simple electro-capillary currents might, on account of their small intensity, be used as units for comparing electromotive forces in general; but such couples, when there is no metallic reduction, not being of constant current, this application is limited. 5. One may have an idea of the difference which exists between the capillary affinities exercised by the walls on each of the two solutions, and the affinities uniting their constituent parts, from examining on which side precipitates are formed, within or without the crack. If within, this shows that the capillary affinity is less for the exterior than for the interior liquid.

Heat Liberated in Reaction Between Alkalies and Water, Potash and Soda.—M. Berthelot.—A thermo-chemical study which scarcely permits of being summarised.

Combinations Formed under the Influence of the Solvent Electric Discharge (Effluve) by Marsh-Gas and Carbonic Acid on the One Hand, and by Carbonic Oxide and Hydrogen on the Other.—MM. P. and A. Thenard.—In opposition to Sir B. Brodie's results, as given in our issue of 18th ult., these observers state that they found in the cases of both mixtures the contraction *continuous*; and that the product was in the form of a *liquid* condensed on the sides of the tube in drops, at first colourless but later becoming amber coloured, and

passing from the oleaginous to the viscid state. Analysis gave somewhat negative results as to the chemical nature of the products in the two tubes (an aqueous solution had a strong smell of metaceton along with formic products; and the liquid in the second tube, treated with potash, alcohol, and ether, gave a precipitate resembling beer yeast, but which produced no fermentation); it was sufficiently evident, however, that very numerous and complex products are obtainable by this process. The authors add that the silent discharge is capable of dissolving certain organic bodies such as acetic acid; which, under its influence, gives carbonic oxide or marsh-gas, leaving a brown product soluble in potash. They are having new apparatus constructed specially for the above class of experiments.

Certain Spectroscopic Observations.—P. A. Secchi.—Referring to the dark line observed with the spectroscope, at the base of the chromosphere, and separating this from the edge of the solar disc, P. Secchi thinks it sufficiently explained by absorption in the chromosphere. Supposing the chromosphere 10 or 12 seconds high, certain rays from the deeper regions (he calculates) would have to traverse as much as 100,000 kilometres of its matter to reach the observer. He opposes the assertion that the chromosphere is wanting at the spots (M. Faye maintained on behalf of his theory that the hydrogen was in such a case "engulphed") stating that, in hundreds of observations, he found it absent only once, and then not near a spot. He supposes some unknown body to have intervened. The assertion referred to had arisen from observing that the weak light of hydrogen disappeared when the brighter light from a mixed layer of hydrogen and metals appeared in the field of the telescope. By narrowing the slit the bright line C would appear above these very bright masses. P. Secchi further gives an account, with sketches, of a remarkable ramified mass of hydrogen he observed on April 3, the upward velocity of which he estimates at 90·5 kilos. per second. It was quite isolated all the time. He is led to think the solar atmosphere must extend at least eight minutes; and he finds his observations justify Lord Linsay's photographs, and confirm M. Janssen's view as to the dynamic state of the solar atmosphere.

Application of the Pandynamometer to the Measurement of Work Done by a Steam-Engine, according to the Flexure of the Beam.—M. G. A. Hirn.

Extract from Memoir on the Application of the Mathematical Theory of Elasticity to the Study of Articulated Systems Formed of Elastic Rods.—M. Maurice Levy.

Examination of Differences Presented by the Spectrum of Chlorophyll according to the Nature of the Solvent.—M. Chautard.—The author operated with solutions of chlorophyll in alcohol, ether, chloroform, various essences and oils, sulphide of carbon, &c. Among the oils he distinguishes between those which are naturally quite inactive with the prism and those which, with sufficient thickness, produce an absorption of certain rays. Among the latter are the oils from olive, colza, flax, and laurel; and the bands produced are, according to the author, due to the presence of chlorophyll, whether in the fleshy envelope (as with olive) or in the cotyledons of the seed. All these fruits and seeds, treated directly with alcohol, give a liquor having spectral properties which correspond to those of the oil. An alcoholic solution of ripe olives gives a spectrum somewhat different from that obtained with the ripened fruit.

Vapours Emitted at the same Temperature by the same Body in Two Different States.—M. J. Moutier.—M. Moutier had formerly shown that such vapours had different tensions. Water at zero, *e.g.*, emits vapour, the tensions of which are unequal, according as the water is taken in the liquid or the solid state. He now finds these results confirmed, from a study of the specific heats of saturated vapours.

Emission Spectrum of Erbine.—M. Lecoq de Boisbaudran.—Erbine is one of the few solid substances which produce a discontinuous spectrum of bright lines. According to MM. Bunsen and Bahr, the addition of phosphoric acid simply intensified the bright lines, but the present observer finds that it produces a spectrum quite distinct from that of erbine alone.

Observations Relative to M. Du Moncel's Last Note on the History of the Silent Electric Discharge.—M. Arn. Thénard.—The writer claims the priority of having effected the dissociation of carbonic acid by this new agent.

Experiments on the Effects of Dynamite.—MM. Roux and Sarrau.—These experiments clear up some obscure points. Dynamite inflamed by violent percussion, as that produced by the detonation of a strong fulminating capsule, give an explosion even in free air, and, if confined, produces an effect such that 1 of nitro-glycerine corresponds to at least 10 of ordinary powder. Inflamed by any other means, without percussion, it is simply fused in free air, and, if confined, it may explode, but this explosion, whatever the temperature and pressure, is of an entirely different nature from that of the *first order*, or detonation. An explosion of the *second order* is such that 1 of nitro-glycerine corresponds to about 2 of powder. The experiments were chiefly made with metallic bombs. A dynamite is more powerful in proportion as it is more easily inflamed through percussion. Where not readily inflamed, only part of the mass detonates, the rest acting by simple explosion.

Bulletin de la Société Chimique de Paris, April 20, 1873.

At a meeting of the Society, held on March 21st, M. Grat West explained the object and principles of his work — "Statistique des Volumes des Equivalents Chimiques." He proposes to reconcile the present chemical theories, to admit the electric popularity of molecules. M. Jannetaz presented a copy of his thesis on the propagation of heat in crystalline bodies. He arrives at the general law, that in crystals the major axis of conductibility is parallel to the easiest cleavage.

Researches on the Double Decomposition of Saline Solutions.—L. Joulin.—This important paper will shortly appear at full length.

Decomposition of Metallic Carbonates of Heat.—L. Joulin. (See p. 211).

Crystalline Benzoic Acid obtained from Benzoin.—M. Guichard.—In order to study the solvent action of bisulphide of carbon upon certain pharmaceutical products, the author placed, on June 23rd, 1870, gum benzoin to macerate in this solvent. During the siege of Paris the bottle was placed in a shed, and exposed to all the variations of temperature through the winter. On his return the benzoin was found solidified in the upper part, and under it voluminous crystals were fixed like stalactites. The bisulphide almost entirely evaporated in the water-bath, deposited on cooling very brilliant macreous spangles grouped in stars, and tainted with a little resinous matter. These crystals, as well as the former, had all the properties of benzoic acid.

Heat Disengaged in the Reaction of Hydracids and Water, and on the Molecular Volume of Solutions.—M. Berthelot.—This paper also is reserved for insertion at length.

On Rosolic Acid.—MM. Prud'homme.—The procedure generally employed in the manufacture of this acid, commercially known as coralline, is heating for 5 to 6 hours to about 140° or 150° C. a mixture of 1 part oxalic acid, 1½ parts phenol, and 2 parts sulphuric acid. Fresenius ascribes the formation of rosolic acid to the action of nascent oxide of carbon upon sulphophenic acid. The author holds that the presence of a sulpho-conjugate acid is unnecessary, and that the sulphuric acid merely acts as a dehydrator. In fact, rosolic acid is formed if the sul-

phuric acid is replaced by the boracic, arsenious, or arsenic acid. The two former of these if heated alone with phenol do not yield a trace of colouring matter. Arsenic acid alone with phenol gives a colouring matter, which Fel has named xanthic acid, but which must not be confounded with rosolic acid. If phenol is heated with sublimed oxalic acid, free from water of crystallisation, rosolic acid is produced. Ordinary oxalic acid heated for several hours with phenol yields no rosolic acid. If, however, certain points of the flask in which the reaction takes place are superheated traces of colour are produced at these points, as the case of sublimed oxalic acid is thus reached. From these experiments it appears that the formation of rosolic acid is simply due to the direct action of the nascent carbonic oxide. Fresenius has shown, by direct experiments, that the carbonic acid arising from the oxalic acid is without influence. Kolbe has put forward the hypothesis that rosolic acid may be regarded as formylic phenol, according to the equation $-C_6H_5OH+CO=C_6H_4COHOH$. The hypothesis agree with the author's experimental results.

Characteristic Properties of the Common Oils.—M. G. Glœsner. (See p. 212).

Les Mondes. Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxx., No. 17, April 23, 1873.

Combustion of the Diamond.—An experiment lately made by Mr. Spence, of Manchester, seems to prove that under certain conditions the diamond is combustible at a much lower temperature than has been hitherto supposed. A South African diamond of the size of a small pea, coated with refractory clay, was placed in a crucible with a mixture of soda and hydrate of lime, and then heated in a muffle for three days and three nights. On opening the mass, it was found that the diamond had entirely disappeared, although the heat had never exceeded a cherry-red.

New Mode of Preparing Animal Manures.—Coignet proposes to treat animal refuse of all kinds with superheated steam to effect its conversion into manure without nuisance. He is convinced that this will be the best method of treating the offal of the slaughtered oxen on the La Plata.

Highly Soluble Collodion.—Adolphe Martin recommends the following form of gun-cotton for the preparation of collodion:—Take two parts of sulphuric acid at 66° Baumé, to which is added one part of dry nitrate of potash. When the mixture has reached the temperature of 55° C., cotton is put into it by small portions, taking care to immerse and saturate them as rapidly as possible. After steeping for seven or eight minutes, the whole is thrown at once into a large quantity of water, and washed rapidly till completely neutral. It is then carded with copper cards, to eliminate all pulverulent matters. 8 grs. of cotton are used to 300 grs. of the acid mixture.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 245, May, 1873.

Report of the Prizes Offered by the Society and Awarded in 1873.—*Chemical Arts.*—Six prizes have been offered: 1. Prize of 2000 frs. for the industrial application of distilled water; no candidate. 2. Prize of 1000 frs. for the industrial application of any cheap and abundant mineral product; no candidate. 3. Prize of 1000 frs. for a useful application of recently discovered metals; no candidate. 4. Prize of 3000 frs. for the artificial preparation of a black compact diamond; one candidate appeared, but, as the experiments of the Committee showed that the specimens sent did not fulfil the conditions required, the prize was not awarded. 5. Prize of 1000 frs. for a process capable of effecting the prompt and durable disinfection and clarification of sewage; the Engineers of the Municipal Service of Paris, commissioned to study the question of disinfection and the applications of sewage-water, have presented a complete and detailed account of the experiments made, and the remarkable results obtained; as these experiments have been conducted on a very small scale, and, as important sewage works are in progress, the Council of the Society has decided to suspend the award of the prize. 6. Prize of 1000 frs. for refining, in France, Bolivian nitrate of soda, and extracting the iodine which it contains. *Economic Arts.*—Prize of 3000 frs. for an apparatus giving an electric current constant in direction and intensity, whose electro-motive force and conductibility shall be comparable to those of a nitric acid battery of sixty to eighty ordinary sized elements, and showing superiority in economy or salubrity over the machines now in use; the prize was awarded to M. Gramme for his magneto-electric machine.

Revue Universelle des Mines, de la Metallurgie, des Travaux Publics, des Sciences et des Arts Appliqués a l'Industrie, November and December, 1872.

The Mines of the Island of Sardinia.—M. Sella.—From this long and elaborate report we extract the following:—The minerals constituting the metalliferous deposits of the island are very various. Those most generally met with are sulphide of lead, more or less argentiferous, sulphide of zinc (blende), sulphide of iron, or ordinary pyrites, as well as double sulphide of iron and copper. The sulphides of zinc and lead are often accompanied, at least in the upper part of the deposits, by oxidised minerals, such as carbonate of lead (cerussite), sulphate of lead (anglesite), and carbonate and silicate of zinc, which in Sardinia are both designated calamine. Less abundant are sulphide of antimony, sulph-arsenides and sulph-antimonides of copper, of cobalt and nickel, grey copper and nickel. Still more rare are silver and pyrargirite. The proportion of silver in the galenas is very variable. That found in the veins, properly so-called, is much more argentiferous than those of the beds, in accordance with the calcareous stratification in the district of Iglesias. In these latter deposits, the silver ranges from 12 to 25 grms. per quintal of ore, but occasionally it amounts to 35 to 50 grms. in the mixed beds of galena, carbonate of lead, and calamine. In the veins, properly so-called, the amount of silver is rarely below 30 to 35 grms., and varies generally from 50 to 120 grms. A part of the mine of Sangiorgio regularly yields 560 grms. per quintal of ore, or 900 per quintal of lead.

Essay on Blast-Furnaces.—L. Gruner.—This paper does not admit of abstraction, whilst its great length and speciality prevent its insertion *in extenso* in our columns.

The Oxyhydrogen Light.—Report of F. Le Blanc, Gas-Tester to the city of Paris.—The author considers it proved that the manufacture of oxygen on the large scale is quite practicable. The proportion of nitrogen present was not found less than from 13 to 14 per cent, and, from a variety of causes, a higher standard of purity can scarcely be expected. There has been no opportunity of verifying the inventor's statement concerning the length of time—a year at least—that the manganate of soda will serve without revivification. To keep the reagents in a serviceable state in the retorts, the air admitted must be previously deprived of its carbonic acid. His conclusion is that the Company Tessie du Motay has not been able to show any commercial economy, and that, for an equal amount of light, the system is more expensive than lighting with ordinary coal-gas. There may be certain special cases where this light, possibly too brilliant for ordinary use, will be advantageous. The hygienic employment of oxygen in hospitals is neither practically useful nor preferable to good ventilation. In certain cases, an excess of oxygen in the air might have an unfavourable influence. As regards heating and metallurgical operations, if we except the extraction and fusion of platinum by Ste.-Claire Deville's method, it is by no means demonstrated that this gas would be preferable to atmospheric air.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Mène, No. 16, February 20, 1873.

This number contains no chemical papers, either scientific or technological.

No. 17, February 27, 1873.

The only paper in this number touching upon chemistry or its allied sciences is an account of Gramme's new magneto-electric machine.

Revue Scientifique de la France et de l'Etranger, No. 43, April 26, 1873.

This number contains no chemical or physical papers.

Annales de Chimie et de Physique, April, 1873.

Memoir on the Elliptical Double Refraction of Quartz.—M. Marcel Croullebois.—The purpose of this memoir is (1) a direct demonstration of the existence of the two reciprocal elliptic rays, into which, according to Airy's hypothesis, natural or polarised light, incident on quartz in certain directions, is decomposed; (2) the laws governing this double elliptic refraction, or the transmission of rays through pieces of quartz differently combined, and of contrary rotations. After a mathematical study of the phenomenon, the author describes three bi-prisms he had constructed. The first, which he calls an *elliptic bi-refringent bi-prism*, has the form of a parallelopiped, composed of two prisms of quartz of contrary rotations, with the same refringent angle, and joined by their hypothenuse faces. The terminal faces are inclined at the same angle (80°) to the optic axes, and the two principal sections are at right angles. The instrument can be advantageously used in studying the various forms of polarisation, chromatic, plane, circular, and elliptical. In the second bi-prism, the terminal faces of the two quartz prisms are oblique to the axis, and their principal sections are parallel. The third bi-prism consists of two prisms of the same nature (lævogyrate), with the principal sections at right angles. Various experiments with these instruments are described.

Note on the Fusion of Platinum.—M. Henry Violette.—The writer made some experiments on the fusion of metals in a little draught-furnace (only 1 cubic metre in external volume) which he had constructed at the bottom of an ordinary brick chimney, 30 metres high, in a saltpetre refinery. He could thus obtain an intense heat, rapidly produced, which he thinks might be utilised by chemists in various ways.

Report to the Academy relative to the Observation of the Eclipse of December 12th, 1871, observed at Sholoor, Hindustan.—M. I. Janssen.—This detailed account is in four parts—the choice of instruments, the voyage, the observation, and discussion. The last refers mainly to the nature of the "coronal atmosphere."

Considerations on the Disaggregation of Rocks: Increase of Volume in Crystallisation.—M. Fred. Kuhlmann.—The author gives several examples of the fixation of water in crystallisation of salts at low temperature; the increase of volume having been found always proportionate to the quantity of water fixed. By such increase, M. Kuhlmann explains the swelling and distortion sometimes observed in building-plaster, the destruction of monuments, the disaggregation of pyrites exposed in moist air, and other phenomena. He considers the influence of crystallisable salts in saturated solutions might, in some cases, be substituted for the action of machines in division of rocks, especially felspar and the natural phosphates.

Heat of Solution of Salts.—M. J. Moutier.—Kirchhoff has shown that the thermic effect, when a solid or liquid substance is dissolved in water, is intimately connected with the tension of the vapour emitted by the solution; and he has given a formula which permits of calculating the heat absorbed or liberated by the solution, when one has a table of tensions of vapour furnished by the solution at different temperatures. The formula agrees with experiment in the case of mixtures of sulphuric acid and water, as seen from a comparison of Favre and Silbermann's experiments with those of Regnault. M. Moutier, in the present paper, compares theory with experiment in the case of solutions of salt in water, taking Wüllner's experiments on the vapour-tensions of various solutions, along with those of Persoz as to the heat absorbed by the solutions in similar circumstances. Of the solutions examined by Wüllner, marine salt, sulphate of soda, nitrate of soda, chloride of potassium, sulphate of potash, nitrate of potash, M. Moutier takes the last, by preference, and finds in it a new verification of Kirchhoff's theory.

Review of Foreign Work on Physics.—M. Bertin.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Delivered from October 12 to October 18, 1872.

An improvement in the manufacture of soap. Nicholas Bickford, chemist, Exmouth, Devon. October 14, 1872.—No. 3017. This invention consists in adding to soap, made in the usual way by alkalies, a very finely levigated powder or a solution of French chalk *(cretâ gallica)*.

Improvements in apparatus for the treatment of sewage. Major-General Henry Young Darracott Scott, C.B., Ealing, Middlesex. October 14, 1872.—No. 3028. The first part of the invention (having reference to the clarification of sewage only) relates to the method of supplying the lime to the sewage for the purpose of precipitation by the lime process, the main object being to economise labour, and effect the purpose by mechanical means. The second part of the invention consists in treating the sludge after its separation from the sewage-water, whether by straining, subsidence, or precipitation, by a process in which a stirring movement or agitating of the particles is combined with pressure and filtration.

Improvements in treating sulphides, and in obtaining products therefrom. James Hargreaves, chemist, and Thomas Robinson, iron-founder, Widnes, Lancaster. October 15, 1872.—No. 3032. Sulphides of iron and manganese, or either of them, produced by deoxidising a mixture of oxides of these metals, or either of them, with sulphates of soda and potash, or either of them, are reacted upon by hydrochloric acid either in the gaseous state or in solution in suitable chambers or vessels, and chloride of iron and manganese, or either of them, thereby produced. When in the production of chlorides as above it is desired to produce sulphide of hydrogen we add the hydrochloric acid to non-oxidised sulphides of iron and manganese, or either of them. When we wish to obtain sulphur we take sulphides of iron and manganese, or either of them, after they have been exposed to the air so as to become oxidised.

Improvements in apparatus employed in the manufacture of sulphates of soda and potassa. James Hargreaves, chemist, and Thomas Robinson, iron-founder, Widnes, Lancaster. October 16, 1872.—No. 3052. Our invention relates to improvements in, upon, and connected with the manufacture of sulphate of soda and sulphate of potassa, or either of them, by our direct action process, that is to say, by reacting directly upon chloride of sodium and chloride of potassium, or either of them, with sulphurous acid or its equivalent. First. To facilitate conversion of salt into sulphate, and to secure means whereby discharge can be effected rapidly, we dispose the chambers in a long single line, and construct each chamber with two doors, preferably opposite each other. Second. To facilitate the discharging of sulphate from converting chambers, we dispose the chambers in any convenient position, and construct them each with two or more doors, preferably on opposite sides, so as to be able to employ two gangs of men. Third. To provide means whereby the contents of a chamber can be more easily withdrawn than when the present grids are employed, we rest the carrying bars or supporters on movable pillars; upon withdrawal of these movable pillars the carrying bar or supporters are allowed to fall; the contents are thereby easily reached. Fourth. To construct manufacturing plant economically, and to provide means whereby such plant can be extended at small cost, and also repaired without disturbing general working, we place the series of converting chambers in a line, and dispose the sulphurous acid and gas flue along one side of the line, and the circulating gas flue along the opposite side. The said circulating gas and sulphurous acid flues are provided with lute holes opposite each chamber to receive the ends of movable syphons. Corresponding holes for the other ends of the syphons are formed in the tops of the chambers. Fifth. To provide proper flue space over each converting chamber by durable appliances capable of preventing radiation of heat, we employ instead of a brick arch a metal covering plate or piece; this is made to rest or be supported over the top of the chamber, and salt is placed thereon. In practice we prefer that the distance between the top of the cylinder and the covering plate should be about ten inches. The said plate or piece has, as will

be obvious, holes to receive the salt feed pipes. Sixth. To provide means for cooling the converting chamber, when such becomes necessary from carelessness on the part of workmen or from excessive development of heat during reaction, we construct air passages leading from the atmosphere into the space between the covering plate and the cylinder cover that the air may circulate over the top and downwards around the chamber. Seventh. As means for constructing large converting iron chambers economically, and also for facilitating transport, we construct them each in segments so formed with corresponding edges that they dovetail or hook one into the other. So constructed a new segment can be added at any part. Eighth. To construct the brickwork of converting chambers economically and to prevent loss of heat by radiation we build a thin brick wall around and at a short distance from each chamber. Between the said brick wall and another outer brick wall we place any convenient non-conducting material, such as a mixture of clay and ashes. Ninth. To ensure stability of the outer enclosing brick wall of converting chambers we build flat metal plates therein and employ vertical stays and cross ties to bind and secure the whole. Tenth. To dispense with the labour of shifting the movable flue after a converting chamber has been newly charged we construct a flue to each chamber within the enclosing brickwork, and employ a movable metal plate or door to close the outlet from the chamber which is for the time being the last of the series. Eleventh. To remove the gases remaining in a chamber after conversion has taken place and prevent their escape into the atmosphere we connect a movable syphon or passage with another chamber or with a flue to conduct the said gases to the condensing apparatus. Twelfth. To ensure that there is no leakage of gas past the valves we dispense with the fixed necks and employ movable necks or syphons to connect the chambers to the sulphurous acid flue and also to each other. Thirteenth. To provide means whereby the sulphurous acid or the circulating gases may be heated and the undue heating of the converting chambers thereby avoided, we construct the flues with spaces around or in contact with them, and into these spaces we admit heating gases. Fourteenth. To evenly charge a converting chamber with salt we construct a top with two or more courses of feed holes. Fifteenth. To render durable the steam jet nozzles and the throats through which the evolved hydrochloric acid and other gases are forced we construct such nozzles and throats of glass or earthenware. By throats we mean constricted passages through which the gases are caused to flow by the action of a jet of steam.

An improved composition for preserving wood, metal, stone, brick, paper, textile and felted fabrics, cordage, and cables. W. Morgan-Brown, engineer and patent agent, 38, Southampton Buildings, London, and 13, Rue Gaillon, Paris. (A communication from Frédéric-Oscar Möller, of 22, Rue Lavoisier, Paris.) October 17, 1872.—No. 3067. This invention is for a composition for preserving wood, metal, stone, brick, paper, textile and felted fabrics, cordage, and cables, and is composed of gas-tar, marl, acetate of lead, alum, and sulphate of ammonia.

Improvements in the treatment of beer in order to prevent and remove acidity. H. Bethell, brewer, Victoria Street, Westminster. October 18, 1872.—No. 3080. This invention consists in the combined use of carbonates of potash and carbonates of ammonia in the treatment of beer in order to preserve it or prevent it becoming acid, and also to remove acidity from sour beer.

NOTES AND QUERIES.

Zinc Powder.—(Reply to R. A. R.)—Metallic zinc is somewhat brittle at ordinary temperatures, but heated to 200°, it may be readily pulverised in an iron mortar heated to the same temperature.

Deodorising Naphtha.—(Reply to Peter Trumble.)—You may greatly improve the oil by distilling it over quick-lime first, and filtering it next over granulated and freshly burnt wood-charcoal, but this will not entirely remove the smell.

Crystallising Pan for Nitrate of Lead.—(Reply to "Constant Subscriber.")—Use a leaden pan jacketted with iron if you use steam, and if fuel, let the lead rest on an iron plate so as to protect it from the direct action of the flame.

Crystallising Pan for Nitrate of Lead.—Some time ago I had a quantity of nitrate of lead to crystallise and the same difficulty presented itself. I found, however that it crystallised in a large stoneware pan without much trouble. The stone pan was put into a non-seam jacket with an india-rubber washer between them; and the steam was held in by the weight of the pan, though of course much pressure cannot be used.—B. P. M.

MEETINGS FOR THE WEEK.

MONDAY, 19th.—London Institution, 4.
TUESDAY, 20th.—Royal Institution, 3. Mr. J. H. Parker, "On Roman History and Architecture."
—— Civil Engineers, 8.
—— Anthropological, 8.
—— Zoological, 8.30.
WEDNESDAY, 21st.—Society of Arts, 8.
—— Pharmaceutical, 11 a.m. (Anniversary.)
THURSDAY, 22nd.—Royal Institution, 3. Prof. Tyndall, "On Light."
FRIDAY, 23rd.—Royal Institution, 9. Mr. Spottiswoode, "On the Spectra of Polarised Light."
—— Quekett Microscopical Club, 8.
SATURDAY, 24th.—Royal Institution, 3. Mr. J. Morley, "On the Historical Method."

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Hours of Lecture for Session 1872-73 :—

Chemistry (Inorganic)	10 a.m.	Materia Medica	4 p.m.
,, (Organic)	2 p.m.	Pharmacy	2 p.m.
Botany (Structural) ..	11 a.m.	Classics (Junior)	9 a.m.
,, (Systematic)..	3 p.m.	,, (Senior)	4 p.m.

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THE CHEMICAL NEWS.

Vol. XXVII. No. 704.

MANGANESE A SUBSTITUTE FOR NICKEL IN GERMAN SILVER.

In a letter to the *Times*, Dr. Percy, referring to the high price of nickel, says:—

"With your permission, I will now disclose, for the first time, a fact which may, perhaps, surprise, and will certainly interest, electro-platers. More than 20 years ago I was engaged, at the largest German-silver works in this country, in an investigation which had for its object the discovery, if possible, of a substitute for nickel in German silver. The result was successful; every difficulty was surmounted, and an alloy was produced on a manufacturing scale which so perfectly resembled German silver that it was sold as such by way of experiment to electro-platers accustomed to the use of that alloy, without their discovering any difference between the two. The substitute was the metal manganese, and, although this metal cost very much less than nickel, yet it was decided for commercial reasons not to proceed further in the matter, the manufacture of German silver being at the time highly remunerative. The firm to which I have alluded has it in its power at any time to introduce the manganese alloy, and if it should be unwilling to do so it will certainly be done by other persons. At present I refrain from making known either the composition of this alloy or the details necessary to guide the manufacturer, though it is my intention to publish both on a future occasion. What I here announce will, I trust, serve as a hint to practical metallurgists, and may induce them to work at the subject."

In consequence of the interest which this subject is now causing, it will perhaps be useful if we remind our readers of a paper on "Alloys of Copper, Tin, Zinc, and Lead, with Manganese," by Mr. J. Fenwick Allen, F.C.S. This paper was read at the Liverpool meeting of the British Association in 1870. We extract the following:—

"Having obtained a comparatively pure oxide of manganese, and having mixed this with oxide of copper, not metallic copper, together with wood charcoal, all finely ground and intimately mixed, the charge was put into a plumbago crucible, then heated in an air-furnace at an intense heat for from three to four hours. It was found when the pot was taken out, that, still suspended in the charcoal, and not run down to the bottom, were innumerable fine shots of a bright white metal; these being separated by washing and placed again in the crucible and heated, fused, I may say easily, into a prill or button covered with a green layer of vitreous slag.

"The process was continued until some ingots were produced, and in these experiments were made as to their malleability and ductility. This knife-blade is the first piece that was successfully passed through the rolls.

"The alloy was found to be very hard and very brittle when hot, but when cold, although still hard, it rolled with ease and was highly elastic.

"The proportions of the alloy were about—

Copper	.. ..	75 per cent.
Manganese	.. 25	,,

"When the simple alloy had been produced in sufficient quantities, compound alloys with zinc were tried in various proportions, and these again rolled with complete success.

"Certain mixtures of copper, zinc, and manganese possess the advantage both over German silver and yellow metal, that, whereas the one will only roll cold, and the other hot, the manganese alloy rolls from hot to cold.

"The laboratory experiments having been completed, an air-furnace was built in which a 100-lb. plumbago crucible was used.

"The results were precisely the same as those obtained in the laboratory, only it was found that, by stirring the charge a few minutes before the crucible was taken out of the fire, by far the greater portion of the metal that before was in small fine shot, needing very careful washing, now settled to the bottom of the pot, and could be poured out as a bar or ingot, the slag also melting, and the unconsumed charcoal floating on the top. This experiment was continued until several hundredweights of the alloy were produced, so that it may be subjected to various tests, and also that some approximate estimate of its cost and value might be formed.

"As a simple alloy, in which the proportions of manganese ranged from 5 per cent to 30 per cent, it is both malleable and ductile, with a tenacity considerably greater than that of copper.

"With zinc a compound alloy very closely resembling some of the qualities, not the best, of German silver is obtained. The alloy of copper and manganese would also combine with tin, lead, and other metals, and from these castings were made which were applied as bearings for machinery.

"A furnace planned by Mr. Siemens has supplied the intense heat needed, with a non-oxidising flame, in a quiet atmosphere.

"It merely remains for me now to place before you the following series of specimens:—

"1st. Manganese and copper in various proportions from 35 per cent to 5 per cent of iron, as ingot, sheet, or wire.

"2nd. Copper, zinc, and manganese, also in different proportions, and in a variety of applications.

"3rd. Copper, zinc, manganese, and tin as ingots and as bearing.

"4th. Copper, manganese, and tin in several different proportions as bars.

"5th. Copper, manganese, and lead."

The metallurgy of manganese has perhaps received its most important development from the researches of Mr. Hugo Tamm, first published in our pages eight months ago. He says—"The metal obtained by the new process is not pure manganese; it is to manganese that which cast-iron is to iron, and I will henceforth call it cast-manganese. But it is prepared with common materials, and the superiority of the process consists in this, that with a given manganese ore the cast-manganese is purer than the corresponding metal extracted by another process, and lastly, it is obtained with greater facility, greater security, and at less expense than with ordinary means, and, what is most important of all, it may be prepared in unlimited quantity.

"My endeavours were directed from the first to the reduction of manganese ores in presence of a flux.

"*Preparation of the Fluxes.*—Two fluxes are required for successful and really practical operations in the smelting of manganese. One which I will call flux No. 1, or white flux, and which is obtained by mixing well together common ground bottle glass free from lead, quick-lime, and fluor-spar.

"The second flux, flux No. 2, or black flux, is theoretically required for the smelting of manganese, and it can be used in practice. It is formed by mixing together flux No. 1, native oxide of manganese of good quality, very fine charcoal powder, soot, or lamp-black.

"This flux may be used just as it is obtained after mixing. But it is best to incorporate the mass by adding enough of an oil to form a thick paste, and heating the whole at a high temperature in a closed crucible. The oxide of manganese is reduced to the state of protoxide; the flux assumes a fine olive-green colour.

"But on the whole, the best and safest mode of operating is the following:—A mixture is made of—

Flux No. 1	34 parts.
Lamp-black, or soot of good quality	5½ ,,
Peroxide of manganese, native, of good quality	60½ ,,

And it is smelted as will be hereafter described. 17½ parts of cast-manganese are obtained, and the slag, which presents a fine olive-green colour, is ground. It is saturated with protoxide of manganese, to which it owes its colour, and it forms an admirable flux, either for the smelting of manganese ores or for their docimastic assaying.

"*Preparation of the Crucibles.*—The following plan which I devised is so simple and so effective that not only is every difficulty removed, but special advantages are attached to its use.

"Three parts of plumbago and 1 part of loam or fire-clay are mixed together, and made into a thick paste with water, and the crucible is as equally as possible lined with this paste, which holds firmly to its sides. The thickness of the lining varies with the size of the crucible, but with the largest crucibles it should not exceed half an inch.

"*Smelting of Manganese Ores.*—Any crucible which will stand a white heat for several hours without softening can be used. It is lined with loam and plumbago, as I have previously described, and then the following mixture is introduced into it:—

Native oxide of manganese, of good quality	1000 parts.
Lamp-black or soot, of good quality	91 ,,
Green flux	635 ,,

Oil, in sufficient quantity to merely wet the mixture.

"The mixture is introduced in the crucible and slightly pressed in, and a round cover of thick wood is placed over it. It is carbonised during the smelting, and forms a charcoal cover which protects admirably the mixture from oxidation, and it can be used several times.

"The clay or plumbago cover is placed over the crucible, and the joint is luted with a little thin fire-clay. A small aperture is kept to allow the gases to escape.

"The crucible is then placed in a wind- or blast-furnace, and slowly heated so long as fumes escape from the crucible; the heat is rapidly increased until it reaches white heat, and the furnace is maintained at that high temperature for several hours.

"When it is thought that the operation is done, the fire is allowed to burn away, and the crucible is left to cool. The cover is then removed by means of a chisel introduced in the joint. The crucible is turned upside down, and shaken until the slag and metal fall down. The button of metal is detached from its slag with a hammer, and introduced in well-corked or stoppered vessels perfectly dried.

"The slag, which has a fine olive-green colour, breaks up in fragments with large faces affecting a pseudo-crystalline structure, but the grain is really crystalline. It is ground, and used as flux in a second smelting. It is advisable after each smelting to add to the slag, in order to make it more fusible, about $\frac{1}{10}$th of the white flux.

"The mixing of manganese ore, lamp-black, and flux is not an indifferent operation, and to ensure perfect success it should be done in the following way:—The oxide of manganese should be first of all thoroughly mixed with the lamp-black. This mixture should be pretty roughly mixed with the flux, and then oil should be added. By so doing, lamp-black and oxide of manganese remain united during the mixing, and act upon each other during the smelting, before the flux begins to melt, so that the oxide is reduced to the metallic state before the flux can dissolve any portion of it. The residue of carbon left by the burnt oil assists in reducing the oxide of manganese, and in preventing the flux from acting upon it before it has been reduced to the metallic state.

"The only real improvement of importance would be the addition to the flux of a substance which, in small quantities, would assist in obtaining a cast-manganese of a superior quality.

"*Refining of Cast-Manganese.*—There is little doubt that, as soon as manganese is prepared on the large scale and at a comparatively low price, some uses will be found for it. I think that, in certain operations, it might form a good substitute for potassium and sodium; and in that case cast-manganese, such as is obtained after the smelting of its ore, could be used with advantage; but should a purer kind of metal be required for the manufacture of certain special alloys, cast-manganese would have to be refined.

"The simplest way of refining manganese is the method which has been proposed by Berthier, I believe, and which consists in re-melting the cast-manganese coarsely powdered with about one-eighth of carbonate of manganese. The mixture is introduced into a refractory clay crucible, and covered over with a wooden cover similar to the one used in the smelting, to prevent oxidation.

A NEAT METHOD OF TESTING WITH BUNSEN'S FLAME.

By CHARLES HUSON,
Demonstrator in Chemistry, Queen's College, Liverpool.

In principle, this method is similar to that of the Bunsen-stick recommended in some of the recent text-books, but, I think, will be found to be an improvement on it, both in neatness and delicacy, and also in expeditiousness. A thin piece of platinum wire is taken, and a small double loop or cage 2 or 3 m.m. in diameter made at one end. This loop is moistened with water and then dipped into powdered cream of tartar, a small portion of which will adhere. On heating for a few seconds in the reducing zone of the Bunsen flame, the cream of tartar will, of course, be converted into a mixture of carbon and potassium carbonate. All that now remains to be done is to dip this porous mass of carbon into a solution of the substance to be tested, or (in the case of a solid body) to moisten it with water and attach a grain or two of the assay to it, and, having first driven off the moisture by holding the wire at some distance above the flame, to insert the carbon tip into the upper reducing flame for a few moments. If the solution of the assay be concentrated, or if a solid portion be used, the reduced metal will be plainly visible to the naked eye; but, in the case of a dilute solution being used, the metallic grains can only be seen by rubbing the carbon tip in a small agate mortar with a few drops of water.

In testing a volatile substance, *e.g.*, arsenic, antimony, cadmium, &c., a small evaporating basin, half filled with cold water, should be held just above the carbon tip, and almost in contact with it, upon which an incrustation or mirror will be found.

As instances of the extreme delicacy of this mode of testing, I may mention the following, among other results of careful experiments which I have made:—

(1). A solution of 0·1 grm. of As_2O_3 in 50 grms. of water was made, and the carbon tip dipped once into it. On heating, the arsenical mirror was produced almost instantaneously upon the evaporating dish held in the flame.

(2). The carbon tip was moistened with a solution of 0·1 grm. of crystallised copper sulphate in 10 grms. of water. On pressing the residue in an agate mortar, minute copper scales were distinctly visible.

(3). A solution of 0·1 grm. of silver nitrate in 40 grms. of water was used, with a corresponding result, only that the silver scales were more distinct.

I also tried a solution of As_2O_3 of half the strength of the above-mentioned one (viz., 1 of As_2O_3 in 1000 of H_2O), and even in this case got a slight mirror, which dis-

appeared when moistened with chloride of soda. As in each of the above experiments the portion of solution actually used was less than 0·05 grm., the amount of metal present will be seen to have been extremely minute, viz. :—

In (1) ..	0·0001 grm. As_2O_3	=	0·000075 As.
,, (2) ..	0·0005 ,, $CuSO_4 5H_2O$	=	0·00013 Cu.
,, (3) ..	0·00012 ,, $AgNO_3$	=	0·00008 Ag.

In testing for a volatile metal, care must be taken to heat the cream of tartar long enough to expel the whole of the inflammable gas before heating with the assay, otherwise the mirror will be obscured by, or contaminated with, a deposit of soot, which will of course destroy the delicacy of the test.

In the case of non-volatile bodies this precaution need not be taken; on the contrary, it is better to only partially carbonise the tartar, since it has then a more strongly reducing effect. The presence of a very slight trace of sulphur may be detected by moistening the residue, after heating, on lead-paper or silver. I have tried moistening the carbon tip with strong solution of KCy, but without increasing the delicacy of the test.

In conclusion, I must mention that the idea of using cream of tartar originated with my friend and teacher, Professor G. Hamilton, F.C.S.

ON THE

EFFECTS OF MAGNETISATION IN CHANGING THE DIMENSIONS OF IRON, STEEL, AND BISMUTH BARS; AND IN INCREASING THE INTERIOR CAPACITY OF HOLLOW IRON CYLINDERS.*

By ALFRED M. MAYER, Ph.D.,
Professor of Physics in the Stevens Institute of Technology.

PART I.

I PURPOSE giving, in a series of papers, the results of a prolonged and careful research on the above subject.

Introduction.—In 1842 Joule discovered that when a current of electricity was passed through a helix which enclosed a bar of iron, the latter, on its magnetisation, suddenly elongated a minute fraction of its length.

To present clearly Dr. Joule's experiments, we will give these abstracts from the excellent paper which he published in the *Philosophical Magazine* in 1847.

"In order to ascertain how far my opinion as to the invariability of the *bulk* of a bar of iron under magnetic influence was well founded, I devised the following apparatus. Ten copper wires, each 110 yards long and $\frac{1}{20}$th of an inch in diameter, were bound together by tape, so as to form a good, and at the same time very flexible, conductor. The bundle of wires thus formed was coiled upon a glass tube 40 inches long and 1½ inches in diameter. One end of the tube was hermetically sealed, and the other end was furnished with a glass stopper, which was itself perforated so as to admit of the insertion of a capillary tube. In making the experiments, a bar of annealed iron, 1 yard long and ½ an inch square, was placed in the tube, which was then filled up with water. The stopper was then adjusted, and the capillary tube inserted so as to force the water to a convenient height within it.

"The bulk of the iron was about 4,500,000 times the capacity of each division of the graduated tube; consequently a very minute expansion of the former would have produced a very perceptible motion of the water in the capillary tube; but, on connecting the coil with a Daniell's battery of five or six cells (a voltaic apparatus quite adequate to saturate the iron), no perceptible effect whatever was produced either in making or breaking contact with the battery, whether the water was stationary in the stem, or gradually rising or falling from a change of temperature. Now had the usual increase of length been unaccompanied by a corresponding diminution of the diameter of the bar, the water would have been forced through twenty divisions of the capillary tube every time that contact was made with the battery.

"Having thus ascertained that the bulk of the bar was invariable, I proceeded to repeat my first experiments with a more delicate apparatus, in order, by a more careful investigation of the laws of the increment of length, to ascend to the probable cause of the phenomenon.

"A coiled glass tube, similar to that already described, was fixed vertically in a wooden frame. Its length was such that when a bar 1 yard long was introduced so as to rest on the sealed end, each extremity of the bar was a full inch within the corresponding extremity of the coil. The apparatus for observing the increment of length consisted of two levers of the first order, and a powerful microscope situated at the extremity of the second lever. These levers were furnished with brass knife-edges resting upon glass. The connection between the free extremity of the bar of iron and the first lever, and that between the two levers, was established by means of exceedingly fine platinum wires.

"The first lever multiplied the motion of the extremity of the bar 7·8 times, the second multiplied the motion of the first 8 times, and the microscope was furnished with a micrometer divided into parts, each corresponding to $\frac{1}{2\,2\,\frac{1}{2}\,0}$th of an inch. Consequently, each division of the micrometer passed over by the index indicated an increment of the length of the bar amounting to $\frac{1}{1\,3\,\frac{1}{5}\,2\,8}$th of an inch.

"The quantities of electricity passing through the coil were measured by an accurate galvanometer of tangents, consisting of a circle of thick copper wire 1 foot in diameter, and a needle ½ an inch long furnished with a suitable index.

"The quantities of magnetic polarity communicated to the iron bar were measured by a finely suspended magnet, 18 inches long, placed at the distance of 1 foot from the centre of the coil. This magnetic bar was furnished with scales precisely in the manner of an ordinary balance, and the weight required to bring it to a horizontal position indicated the intensity of the magnetism of the iron bar under examination.

"After a few preliminary trials, a great advantage was found to result from filling the tube with water. The effect of the water was, as De la Rive had already remarked, to prevent the sound. It also checked the oscillations of the index, and had the important effect of preventing any considerable irregularities in the temperature of the bar.

"The first experiment which I shall record was made with a bar consisting of two pieces of well-annealed rectangular iron wire, each 1 yard long, ¼ of an inch broad, and about ⅛th of an inch thick. The pieces were fastened together so as to form a bar of nearly ¼ of an inch square. The coil was placed in connection with a single constant cell, the resistance being further increased by the addition of a few feet of fine wire. The instant that the circuit was closed, the index passed over one division of the micrometer. The needle of the galvanometer was then observed to stand at 7° 20', while the magnetic balance required 0·52 of a grain to bring it to an equilibrium. It had been found by proper experiments that a current of 7° 20' passing through the coil was itself capable of exerting a force of 0·03 of a grain upon the balance; consequently the magnetic intensity of the bar was represented by 0·49 of a grain. On breaking the circuit, the index was observed to retire 0·3 of a division, leaving a permanent elongation of 0·7, and a permanent polarity of 0·42 of a grain. More powerful currents were now passed through the coil, and the observations repeated as before, with the results tabulated below.

* Read before the National Academy of Sciences, in Cambridge, Mass.

"EXPERIMENT I.

Deflection of Galvanometer.	Tangent of Deflection.	Elongation or Shortening of Bar.	Total Elongation.	Magnetic Intensity of Bar.	Square of Magnetic Intensity divided by Total Elongation.
− 7° 20′	128	1·0 E.	1·0	−0·49	240
0	0	0·3 S.	0·7	−0·42	252
− 9 30	167	2·9 E.	3·6	−0·93	240
0	0	1·2 S.	2·4	−0·74	228
−14 48	264	5·9 E.	8·3	−1·42	243
0	0	3·8 S.	4·5	−1·00	222
−23 10	428	10·3 E.	14·8	−1·87	236
0	0	7·6 S.	7·2	−1·26	220
−47 25	1088	16·1 E.	23·3	−2·22	211
0	0	13·9 S.	9·4	−1·35	194
−58 50	1653	14·8 E.	24·2	−2·21	202
0	0	13·3 S.	10·9	−1·35	168"

Dr. Joule now reversed the current in the helix, and found that a current which deflected the needle 6° 15′ *shortened* the bar 3·4 div., and that after the current was broken its magnetic intensity was found reduced from −1·3 (the permanent intensity previously given by 47° 25′, see preceding table) to −17. He then passed a current of 9° 55′, and this he found was sufficient, not only to remove the former minus polarity of the bar, but also to give it a permanent polarity of +0·25, and yet to leave the bar with 6·6 of the elongation belonging to its previous minus polarity.

Taking Joule's observations while the current was passing around the bar, we have for the current of 6° 15′ a magnetic intensity of −0·12, and for the current of 9° 15′ a *plus* magnetic polarity of 0·57. We call attention to these results because subsequent experimenters * seem to be unaware of these observations of Dr. Joule, who here first shows that a feeble current will demagnetise, and even reverse, the polarity of a bar which has previously required a far more powerful current to give it its permanent magnetic charge. In the experiment given above, the ratio of the current intensities of permanent magnetisation and of demagnetisation is 1088 to 175.

Dr. Joule now successively replaced the above bar by two others, and obtained with them similar results. He then deduces the following important law:—"From the last column of each of the preceding tables we may, I think, safely infer that *the elongation is in the duplicate ratio of the magnetic intensity of the bar*, both when the magnetism is maintained by the influence of the coil, and in the case of the permanent magnetism after the current has been cut off. The discrepancies observable will, I think, be satisfactorily accounted for when we consider the nature of the magnetic actions taking place. When a bar experiences the inductive influence of a coil traversed by an electrical current, the particles near its axis do not receive as much polarity as those near its surface, because the former have to withstand the opposing inductive influence of a greater number of magnetic particles than the latter. This phenomenon will be diminished in the extent of its manifestation with an increase of the electrical force, and will finally disappear when the current is sufficiently powerful to saturate the iron. Again, when the iron, after having been magnetised by the coil, is abandoned to its own retentive powers by cutting off the electrical current, the magnetism of the interior particles will suffer a greater amount of deterioration than that of the exterior particles. The polarity of the former may indeed be sometimes actually reversed, as Dr. Scoresby found it to be in some extensive combinations of steel bars. Now whenever such influences as the above occur, so as to make the different parts of the bar magnetic to a various extent, the elongation will necessarily bear a greater proportion to the square of the magnetic intensity measured by the balance than would otherwise be the case. For similar causes the interior of the bar will in general receive the neutralisation and reversion of its polarity before the exterior, and hence we see in the tables that there is a considerable elongation of the bar after the reversion of the current, even when the effect upon the balance has become imperceptible, owing to the opposite effects of the interior and exterior magnetic particles."

Joule now experimented on a bar of unannealed iron, and on three bars of soft steel. As these bars had considerable degrees of retentive power, the anomalies occasioned by the above-described actions did not exist to any considerable extent, and they gave a confirmation of the law that the elongation is proportional, in a given bar, to the square of the magnetic intensity.

The next bar he experimented with was of moderately hardened steel. This bar was slightly increased in length every time that contact with the battery was broken, although a considerable diminution of the magnetism of the bar took place at the same time. He says—"I am disposed to attribute this effect to the state of tension in the hardened steel, for I find that soft iron wire presents a similar anomaly when stretched tightly."

In a subsequent communication, contained in the same volume of the *Philosophical Magazine*, Dr. Joule gives accounts of numerous experiments made upon wires and bars of soft iron, cast-iron, soft and hardened steel, subjected to various pressures and tensions while they were magnetised. As an example of the effect of *tension* on the phenomena, he states that in the case of a bar 1 foot long and ¼ of an inch in diameter, a tensile force of about 600 lbs. caused all the phenomena of changes of length to disappear, even with a current which produced a deflection of 58° in the needle of the tangent galvanometer; but when a current of 61° was passed around this bar, subjected to a tension of 1040 lbs., it *shortened* 2·8 div. With a tension of 1680, and the same current, the bar shortened 4·5 divisions. Joule, from his experiments, deduces this law, viz.—*In the case of tension the shortening effect is proportional to the current traversing the coil multiplied by the magnetic intensity of the bar.* He further states that "it is extremely probable that the shortening effects are proportional, *cæteris paribus*, to the square root of the force of tension."

In the case of bars of cast-iron he finds that their elongation is equal, if not superior, to those of soft iron, when magnetised to the same degree; and an increase of tension in them does not produce half the retraction which is caused in soft iron bars in similar circumstances.

Bars of soft steel acted like the bars of iron, but the superior retentive powers of the former enabled him to trace better the elongating effects of the permanent magnetism, which diminished with the increase of tension, and at last disappeared altogether; but with bars of perfectly hardened steel no sensible change in their lengths was produced by charges of *permanent* magnetism, and the *temporary* shortening effect of the coil was proportional to the magnetism multiplied by the current traversing the coil. The shortening effect did not, in these cases, sensibly increase with the increase of tension.

On subjecting bars of wrought- and cast-iron and soft steel to pressure, Joule found that it had no sensible effect upon the extent of their elongation. A hard steel cylinder a foot long, when submitted to the same experiments, with a pressure of 80 lbs., "suffered a diminution of length equal to 0·1 of a division of the micrometer, with a current capable of giving a magnetic polarity of 1·7."

At the termination of his paper, Dr. Joule gives the following "*postscript*:"—"I have already, in the former part of this paper, described an experiment which indicated that no alteration in the *bulk* of a bar of soft iron could be produced on magnetising it. I thought, however, that it would be interesting to confirm the fact by an ob-

* Wiedemann, *Pog. Ann.*, c., p. 235; also R. W. Wilson, "Demagnetisation of Electro-Magnets," *Amer. Journ, Sci.*, 3rd series, vol. iii., p. 346.

servation of the alteration of the dimensions of the iron at right angles to the direction of its polarity. For this purpose I took a piece of drawn iron gas-piping, 1 yard long, $\frac{3}{10}$ths of an inch in bore, and $\frac{1}{10}$ths of an inch in thickness. A piece of thick, covered copper wire was inserted into this tube, and bent over the outside of it. The lower extremity of the iron tube being fixed, and the upper end being attached to the micrometrical apparatus, each division of which corresponded to $\frac{1}{1000}$ths of an inch, I obtained * * * results which show that the length of the tube was diminished, in order to make up for the increase of its diameter, which, in this instance, was in the direction of the polarity. The quantity of the shortening effect, viz., 3·4, is, however, only one-third of that due to the maximum elongation of soft iron bars as observed in the first section. This is probably owing to the grain of the iron being in cross directions with respect to the polarity in the two cases; and partly, perhaps, to the iron tube not being fully saturated with magnetism. The experiment is worth repeating, especially as it affords a means of studying the magnetic condition of closed circuits."

Remarking on the cause of the phenomena of elongation, Dr. Joule says—"The law of *elongation* naturally suggests the joint operation of the attractive and repulsive forces of the constituent particles of the magnet as the cause of the phenomena. On the other hand, the fact that the *shortening effect* is proportional to the magnetic intensity of the bar multiplied by the current traversing the coil, seems to indicate that, in this case, the effect is produced by the attraction of the magnetic particles by the coil. But then it will be asked—Why so remarkable an augmentation of the effect is produced by the increase of tension in the case of the soft iron bars? When we are able to answer this question in a satisfactory manner, we shall probably have a much more complete acquaintance with the real nature of magnetism than we at present possess."

This full account of Dr. Joule's remarkable research is here presented in order to give an exposition of our present knowledge of this subject, and clearly to set forth the relations which my own attempts bear to his labours. Here Joule, the discoverer of these phenomena, has given us almost all the knowledge we have, up to this time, possessed in reference to their characteristics and their laws. That a subject so fascinating should not have been eagerly followed up appears strange; especially so, when it seems highly probable that the faithful study of these actions may one day give us an insight into the dynamic nature of electro-magnetisation, and thus lead the investigator into a fruitful field of research.

No one can duly appreciate this work of Joule's until he attempts the confirmation of his results; then the difficulties of the research and the skill and acumen of this eminent physicist will be properly estimated.

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 15, 1873.

Dr. Odling, F.R.S., President, in the Chair.

The names of the visitors having been announced, and the minutes of the previous meeting read and confirmed, Messrs. R. J. Deeley, J. H. Baldock, and H. Tylston Hodgson were formally admitted Fellows of the Society. The names of Messrs. Archibald Kitchin, James Emerson Reynolds, Robert Wild, and Walter Odling, were read for the first time. For the third time—Messrs. William H. Greenwood and Walter Hills, who were balloted for and duly elected.

The President then called on Dr. Armstrong to deliver his lecture on "*Isomerism.*"

The lecturer, after noticing the comparatively broad signification formerly attached to the term isomeric as applied indifferently to all bodies having the same percentage composition, proceeded to define the terms "polymeric," "metameric," and "isomeric" as now generally accepted, citing the four butylic alcohols and the three dioxybenzenes in illustration of isomerism, and allylic alcohol, propionic aldehyde, propylene oxide, and acetone as examples of metameric compounds, stating, however, that metamerism and isomerism are closely allied phenomena, and that in many instances the one merges almost insensibly into the other. Isomerism is generally regarded as caused by a different arrangement of the same radicals; thus, by the action of chlorine on propane, two monochloropropanes are simultaneously produced, one represented by the expression—

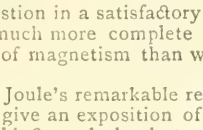
$$\begin{cases} CH_2Cl \\ CH_2 \\ CH_3 \end{cases}$$

the other by—

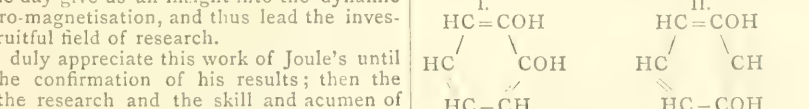
$$\begin{cases} CH_3 \\ CHCl \\ CH_3 \end{cases}$$

the chlorine atom in these two compounds occupying different positions relatively to the carbon atoms, and from each of these derivatives, by the action of various reagents, other isomeric substances may be obtained, the mutual relations of which may be similarly explained.

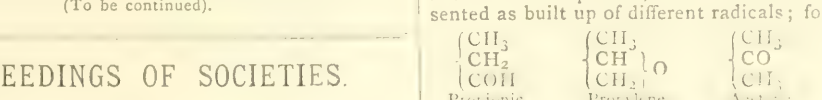
Again, benzene, as far as we know, does not form isomeric mono-derivatives, and this circumstance, taken in conjunction with its forming additive compounds with the monad elements, induced Kekulé to represent it by the symbol—



in which, as the carbon and hydrogen atoms are symmetrically arranged, we should expect to obtain only one of each of the mono-substitution derivatives. Of di-substitution compounds, however, three isomeric forms are known, and these are symbolised by assigning to the radicals different relative positions; for example, the three dioxybenzenes—(I.) hydroquinone, (II.) pyrocatechin, and (III.) resorcin—would be represented thus—



Metameric compounds, on the other hand, may be represented as built up of different radicals; for example—



Propionic Aldehyde. Propylene Oxide. Acetone. Allylic Alcohol.

This is apparently a satisfactory explanation of the phenomena in question, and has, no doubt, greatly forwarded experimental research, but still it is difficult to reconcile many facts which exist with this hypothesis of position; for instance, when ethyl iodide acts on argentic nitrite, it would be expected that argentic iodide and ethylic nitrite—

$$N'' \begin{cases} O \\ (C_2H_5)O \end{cases}$$

would be formed. There is, however, simultaneously produced an isomeric compound, nitro-ethane—

$$N \begin{cases} O \\ O \\ (C_2H_5) \end{cases}$$

Again, Linnemann has found that the decomposition of the nitrite of the propylamine, prepared from normal propylic alcohol, does not yield propylic alcohol, as might be expected, but isopropylic alcohol, and, by treating normal butylic alcohol in a similar way, it may be converted into isobutylic alcohol, and this, in turn, into the tertiary alcohol—

Propylic Alcohol.	Isopropylic Alcohol.	Butylic Alcohol.
$\left\{\begin{matrix}CH_3\\CH_2\\CH_2.OH\end{matrix}\right.$	$\left\{\begin{matrix}CH_3\\CH.OH\\CH_3\end{matrix}\right.$	$\left\{\begin{matrix}CH_3\\CH_2\\CH_2\\CH_2.OH\end{matrix}\right.$

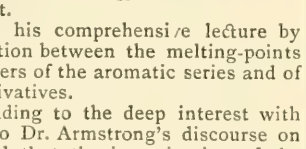
Isobutylic Alcohol.	Tertiary Butylic Alcohol.
$\left\{\begin{matrix}CH(CH_3)_2\\CH_2.OH\end{matrix}\right.$	$C(CH_3)_3.OH$

The assumption that these results are the consequence of intermolecular change appears to be improbable, and they cannot be readily accounted for in any other way which shall be in accordance with the position theory. These anomalous reactions, however, and others of a similar nature, are capable of explanation on the assumption that different amounts of force have been expended in the formation of the isomeric compounds—in other words, isomerides and metamerides are bodies possessed of different potential energies. This view is borne out by the fact that, in the few instances in which the heat of combustion of isomeric organic compounds has been determined, they give different results, as is the case with the metameric compounds, ethylic acetate and butyric acid. This hypothesis is, at all events, capable of experimental investigation and of numerical expression, which is not the case with the position theory. At present, however, we possess no experimental data to enable us to state which members of any series have the lowest, and which the highest, potential energy, but it is probable that the so-called normal primary members of the fatty series possess the lowest potential energy, and are relatively the most stable, since Berthelot has pointed out that of two metameric compounds that which has the lowest boiling-point and density furnishes the most heat on combustion. Of aromatic compounds, one would be inclined by analogy to regard the members of the terephthalic series as the compounds of lowest potential energy and those of the phthalic series the highest.

The author concluded his comprehensive lecture by some remarks on the relation between the melting-points of various isomeric members of the aromatic series and of groups of their haloid derivatives.

The President, in alluding to the deep interest with which he had listened to Dr. Armstrong's discourse on this complex subject, said that the investigation of the potential energy of organic compounds commended itself to chemists as affording a key to the interpretation of the mystery of isomerism. The present way of regarding this as caused by the different grouping of radicals and molecules must be considered as merely provisional, and simply useful as enabling us to co-ordinate facts. In respect to the internal transference of molecules or atoms in organic substances, it was not a new subject; the conversion of ammonium cyanate into urea, and the reconversion of urea into ammonium cyanate, had never been held to contravene the opinion that this substance contained different radicals. There could be no doubt that the physical properties of the various derivatives of benzene afforded great assistance in their classification, and, as the transformation of these compounds is always accompanied by evolution or absorption of heat, the determination of the amount of heat developed by their combustion would be an important element in ascertaining their relations to one another.

Dr. Wright said that in listening to the able address given by the lecturer, he was glad to hear that he did not consider matter to be made up of indivisible particles or atoms, for we should carefully distinguish between the use of symbols to express facts and the employment of them to signify the nature of the body. He might mention that there was another symbolic expression for benzol besides Kekulé's, namely, the following:—



arranged in space in a wedge-shaped form, and having the C's numbered 6 and 5 joined to 1 and 4 respectively; but for his part he failed to see how isomerism could be explained by a difference in the position of the atoms, since these particles or atoms must be continually moving about amongst themselves. He would propose to substitute for the term molecule the word "metropneum" to express the unit of volume of 1 gramme of hydrogen under given conditions of temperature and pressure, and the term "metrogram" for the concrete weight in grammes of a proportion of any given element.

Dr. Mills observed that it was now eight years since he had communicated to the *Philosophical Magazine* what he believed was the first dynamical theory that had been advanced in explanation of this subject, one which was parallel to that proposed by Dr. Armstrong. For instance, in the formation of roseo-chloride of cobalt the action must take place at a low temperature; and if we heat this it becomes converted into the purpureo-chloride of cobalt isomeric with the first. He considered that the second compound had been formed from the first by a further expenditure of energy, and that when the operation was reversed this energy would again be developed. The three nitrobenzoic acids he had investigated afforded another example, the first one melting at 127° when heated, or by the continued action of nitric acid becomes converted into one melting at 136°, and this again into one melting at 140°. He believed that determinations of the heat developed by the combustion of organic compounds would profit but little for the solution of the question, there being no fixed starting-point by which to compare the results. A far more important thing would be the determination of the real units of mass, that is the weights of bodies which perform a unit of work. He had done this for eight nitrates; and many would be surprised to hear that with respect to potassium and sodium the unit of work performed was the same.

Dr. Debus, after having asked Dr. Mills some questions as to the unit of mass and unit of work, urged, as an objection to Dr. Armstrong's remarks on the difference of potential energy of isomeric substances, that this did not satisfactorily explain why the mutual action of silver cyanide and ethylic iodide yielded two isomeric substances at the same time.

Professor Heaton observed that several examples of change occurred in mineral chemistry, as, for example, in mercury iodide and sulphide, and in antimony sulphide. The change from one to another of their metameric or isomeric forms was accompanied by absorption or evolution of heat, and were not usually explained by chemists on the supposition of a difference in position of the atoms.

Sir Benjamin Brodie said that the lecturer had not given them a cut-and-dried theory, but had suggested the investigation of a class of facts which vary with the isomeric forms of compounds, namely, their thermal properties. He thought this, in direct contradistinction to the theory about the arrangement of atoms, was likely to prove far more profitable as it would establish *facts*; and we had no fact to show that certain arrangements of letters represented certain arrangements of atoms. The present theory of isomerism was founded on our ignorance and not on our knowledge—on what we do not know rather than on what we know: as only three di-derivatives of benzene have as yet been obtained it is concluded that only three can exist, and a theory is founded on this and similar suppositions. He believed the views of Dr. Armstrong would lead to something much more tangible.

Professor Clifford remarked that, speaking from the purely mechanical side of the question, the difference

between potential energy and kinetic energy was that the former was regarded as the energy of position, the latter as the energy of motion; and, as in the case before us there was no argument to show that it was purely an energy of position, the term potential energy would be incorrect, he thought it would be better to use the general term energy. In the theory of magnetic induction we conceived a system of small magnets surrounded by currents; such a free system of magnets moving in space would be stable, and might be considered as analogous to the molecular system of an organic compound. Now suppose two magnets vibrating in stable equilibrium with the north pole of the one directed to the south pole of the other, if we introduce a third magnet the relation of the two first will be altered. In a similar manner if a radical be introduced into a given compound, the bonds which unite the atoms are not the same as when the radical is in a different compound.

Dr. ARMSTRONG, in replying, said he was inclined to regard formulæ as merely symbolical representations of facts; he did not believe, for instance, that ethane contained the radical methane, but that the compound was homogeneous. The graphic formula for benzene alluded to by Dr. Wright he thought decidedly inferior to Kekulé's; one great objection to it being that it did not exhibit so clearly the formation of the additive derivatives; also the motion amongst the atoms of a compound was no valid objection to the position theory, as the atoms were supposed to vibrate within certain limits. With regard to Dr. Mills's researches on the three nitrobenzoic acids, it is possible that the substances examined were mixtures; as at the time the experiments were made the great difficulty there frequently is in separating and purifying closely allied organic compounds was not appreciated; many instances of this are known.

The PRESIDENT having proposed a vote of thanks to the lecturer for his able discourse the meeting adjourned until Thursday, June 5, when papers will be read "On the Dioxides of Calcium and Barium," by Sir John Conray, Bart., and "On Iodine Monochloride," by Mr. J. B. Hannay; a new Ozone Generator will also be exhibited by Mr. Wills.

CORRESPONDENCE.

ARTIFICIAL FIBRIN AS A DIETETIC SUBSTANCE.

To the Editor of the Chemical News.

SIR,—I have much pleasure in forwarding you the results of many trials of the dietetic value of this substance in disease, the mode of development of which I had the honour of describing in your valuable periodical in January, 1872. Hitherto its use has been highly gratifying, and attended with the most perfect success. It promises fair to become invaluable in medical practice, especially in cases of feeble alimentation and deficient nutrition, and second to none in those cases where rejection of food forms a prominent feature of the complaint, or where the appetite and digestive powers are reduced to a minimum.

As fibrinous material it is, of course, highly nutritious, and eminently adapted to all cases where there prevails a deficiency of fibrin in the blood. It is, perhaps, unparalleled in its qualities of lightness and digestibility, and is, moreover, "a great delicacy," and differs remarkably, both in its flavour and effects, from the ordinary boiled egg.

In many urgent cases of rejection of food, &c., it not only generally remains where an otherwise prepared egg would not be tolerated, but its presence in the stomach has been found to create a feeling of want rather than of superfluity, and thus to promote, rather than decrease, the appetite for food.

The production of this substance is within the reach of every sick room, and is effected with great facility.

It is formed, it will be remembered, by exposing albuminous material to the operation or influence of cold water for a given period; and, on account of its great plenteousness, we employ the ordinary hen's egg for its production.

When the shell is broken and removed, and its contents are immersed in cold water for some twelve hours or so, it is found to undergo a chemico-molecular change, and to become solid and insoluble.

This change is indicated by the assumption, by the transparent "white of the egg," of an opaque and snowy-white appearance, which far surpasses that of the ordinary egg. The product and the fluid in which it is immersed must now be submitted to the action of heat unto the boiling-point, when the fibrin will be found ready for use.—I am, &c.,

JOHN GOODMAN, M.D.

Southport, May 7, 1873.

ROSOLIC ACIDS, CORALLINES, OR AURINES.

To the Editor of the Chemical News.

SIR,—The abstract in your last number, at page 244, of the paper by MM. Prud'homme, following various others on the same subject, induces me to say a word or two, although I am not as yet prepared to give a detailed account of my own experiments and results.

Until quite lately it was not thought possible to obtain a crystallisable product by the well-known process of treating phenol with sulphuric and oxalic acids, but crystals have at length been obtained by elaborate and roundabout processes of purification, far too expensive and unproductive for commercial purposes. Now I obtained crystals easily quite three years ago, and two years ago I so far improved the process as to obtain a "melt" which at the first boiling with water was wholly converted into a mass of crystals. The crystallisation takes place in a somewhat remarkable manner: the substance appears to become more and more dissolved in the boiling water, until suddenly—the boiling being continued—the liquid begins to glitter like aventurine, and the whole substance, both dissolved and undissolved, becomes crystalline. The substance thus obtained, when re-crystallised from methylated spirit, yields very fine crystals, sometimes quite half an inch long. I enclose a few of the crystals from spirit.

In my opinion there are several quite distinct products obtainable by treating phenol with sulphuric and oxalic acids; otherwise there is no reconciling the varied results got by different chemists. My results, at any rate, are quite opposed to MM. Prud'homme's views. I agree with them that it is not necessary to form phenyl-sulphuric acid, but I do not think the sulphuric acid acts merely as a dehydrator. It is not rosolic acid that is formed by the action of sublimed or dehydrated oxalic acid on phenol. My experiments also contradict the view that the carbonic acid of the oxalic has nothing to do with the reaction, and that it is entirely owing to carbonic oxide. I have obtained a rosolic acid in experiments in which there was substituted for the oxalic acid a substance yielding carbonic acid, but neither formic acid nor carbonic oxide: and I have endeavoured in vain to obtain it when substituting formic acid for the oxalic. I have also produced a rosolic acid from the usual ingredients, with an addition, *without any heating whatever*, and without evolution of carbonic acid.

As a crystalline ammonia compound has been described, I may mention that the finest thing of this kind I have got has been by injecting gaseous ammonia into a solution of the crystalline rosolic acid in acetone. Magnificent crystals are thus produced having a bright blue metallic lustre, which, however, soon disappears on the mother-liquor being filtered off.—I am, &c.,

EDMUND HUNT.

Glasgow, May 19, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, May 5, 1873.

Heat Liberated in the Reaction Between Water, Ammonia, and the Alkaline Earths, Baryta, Strontia, and Lime; Constitution of Alkaline Solutions.—M. Berthelot.—Alkaline liquids do not contain the anhydrous alkalies in the state of simple solutions, nor even of alkaline monohydrates: but they contain in reality like the hydracids certain definite hydrates formed by the association of several molecules of water with 1 molecule of the alkaline hydrate. The existence of these dissolved hydrates is shown in the first place by the formation of crystalline hydrates, as that of potassa, KHO_2+4HO; of soda, $NaHO_2$, and 3HO, and 7HO; of baryta, $BaHO_2+9HO$; and of strontia, $SrHO_2+9HO$. Physical evidence supports the same views. Thus Wuellner recognised, in studying many salts, that the tension of the vapour of water given off by a saline solution experiences a decrease proportional to the weight of salt dissolved. The author has been led to the same conclusion by his thermic studies; the heat given off shows the existence and the formation of several successive hydrates in a solid or dissolved form. The same opinion is corroborated by the phenomena of the precipitation of salts of dehydration. The existence of alkaline hydrates, incompletely formed in concentrated liquids, and which are progressively completed by additions of water, explains, in the author's opinion, the reversal of certain reactions on concentration.

Distribution of Potassa and Soda in Plants.—E. Peligot.—The author has endeavoured to determine whether a plant, watered during the entire period of its growth with water holding in solution common salt and nitrate of soda, absorbs a certain quantity of soda; and whether it takes from the soil other elements from plants of the same species cultivated under identical circumstances, but watered—some with common water and others with potassic and magnesian solutions? The tabulated observations show that the common salt and the nitrate of soda have been totally left by the plants; none of the ashes contained soda. Nitrate of soda acts only in consequence of the acid it contains, which probably combine by double decomposition with potassa or lime.

Action of Ozone on Absolute Alcohol; Combination of Cyanogen with Hydrogen under the Influence of the Electric "Effluve."—M. A. Boillot.—When oxygen or air is passed into absolute alcohol after having traversed the "effluve" apparatus, acetic and formic acids are speedily formed. Acetic ether is also found among the products generated. There is also a white powder, which is deposited on the evaporation of the liquid in the air, and which is soluble in water and alcohol. The experiment on the action of the effluves on a mixture of cyanogen and hydrogen has been repeated, and a notable quantity of hydrocyanic acid has been obtained.

Purification of Hydrochloric Acid.—M. Ergel.—To a litre of the acid are added 4 or 5 grms. of hyposulphite of potassa dissolved in a little water. After a certain time the liquid turns yellow, then brown, and a precipitate is deposited. The acid is left to settle for forty-eight hours, and is then decanted and distilled almost to dryness. The smallest traces of arsenic and of free chlorine are thus removed.

Determination of Sugars by Barreswil's Method.—By M. E. Feltz.—The author has shown, in a former note, that the cupro-tartaric liquid cannot be used to determine glucose in presence of an excess of crystallisable sugar. The experiments were made on saccharine solutions containing only traces of glucose. The determination by means of a standard solution requires in this case a long time, and the reducing action of cane-sugar is thus increased. It might be thought that when operating upon mixtures richer in glucose the error would become insignificant: experiment proved that such was not the case. (I.) A saccharine solution, containing in 100 c.c. 10 grms. of crystalline sugar and 0·398 grm. of inverted sugar, was titrated with 10 c.c. of Vidette's liquid; 0·461 grm. of inverted sugar was found as result. (II.) Another saccharine solution, containing in 100 c.c. 15 grms. of crystalline sugar and 0·298 grm. of inverted sugar, gave 0·378 grm. of the latter. On repeating this latter analysis, adding the saccharine liquid by smaller doses, so as to prolong the process, the apparent quantity was raised to 0·425 grm. It is commonly admitted that cane-sugar is not modified by solutions of caustic soda. An analytical process has even been based on the different action of soda upon glucose and upon cane-sugar. Various experiments have proved that, in the conditions of alkalinity of the cupric liquid, soda reacts upon crystallisable sugar. The errors which may result from the use of Barreswil's method in determining the purity of saccharine products are very serious.

Statistic of the Volumes of Chemical Equivalents and Molecular Considerations.—By M. G. West.—A preliminary notice. The author's object is to ascend from the volumes of compound bodies to those of simple bodies, comparing such only as are of the same dilatability. The more dilatable are considered at low, and the less dilatable at high, temperatures. He is of opinion that by accumulating observations of this nature we may obtain, as regards the chemical and physical properties of bodies, conclusions as precise as those which astronomers obtain in the prevision of celestial phenomena. In equally expansive substances the volumes are commensurable; their common measures constitute the uniform volume of sub-molecules. The same simple body contains a number of sub-molecules, depending on its chemical character. In compounds various components are recognised, some possessing the properties of acids, others of bases, others the deoxidising property of aldehydes, and many being neutral. Compound elements possess always the same chemical property. In ternary organic chemistry the compound elements, to the number of a score, form thousands of substances by adding themselves to each other. The author proposes an explanation of the volumes of sub-molecules; then he explains the expansion of simple bodies in multiple volumes, and their contraction in sub-multiples. He makes use of the heterogeneous character of different portions of a compound molecule to show its electric polarity. By the aid of molecular polarity he explains—(1). The harmony of substitution with electro-chemistry, thus reconciling two conflicting chemical schools. (2). The phenomena of tension-electricity, without the hypothesis of electric fluids. (3). Electric conductibility. (4). The diphlogistication of metals. (5). The reciprocal actions of electrodes and their inductions, without the hypothesis of currents. (6). The reciprocal action between magnets, diamagnetic bodies, and electrodes, without assuming magnetic currents. By the aid of the atomic heat of bodies, and the vibrations of the "ether," the author thinks that he can explain the phenomena of gravitation.

Revue Scientifique de la France et de l'Etranger, No. 44, May 3, 1873.

This number contains no original chemical papers.

Bulletin de la Société Chimique de Paris, May 5, 1873.

Constitution of Hydracids in Solution, and on the Inverse Reactions which they Cause.—M. Berthelot.

Solidifying-Points of Mixtures of Water and of Acetic Acid.—M. E. Grimaux.—We shall endeavour to give this paper in full at an early opportunity.

Derivatives of the Tetrachloride of Naphthaline. —M. E. Grimaux.—Second memoir; this paper is also reserved for insertion.

Action of Chloride of Chloracetyl on Aniline and Toluidine.—M. C. Tommassi.—Aniline and toluidine, under the influence of monochlorated chloride of acetyl, give up an atom of hydrogen in exchange for an atom of chloride of acetyl, and give rise thus to two new crystalline products, phenyl-chloracetamide—

$$\left.\begin{matrix} C_6H_5 \\ H \\ C_2H_2ClO \end{matrix}\right\}\text{-N}$$

and cresyl chloracetamide—

$$\left.\begin{matrix} C_7H_7 \\ H \\ C_2H_2ClO \end{matrix}\right\}\text{-N}$$

These compounds are obtained by a procedure analogous to that directed by the author for the preparation of chloracetylurea (*Bull. de la Soc. Chim.*, tome xix., 243). The only precaution to be taken is to introduce the aniline or toluidine in small quantities at once into well cooled monochlorated chloride of acetyl; rather more than 1 molecule of which is employed to 1 of aniline or toluidine. Phenyl chloracetamide crystallises from its aqueous solution in fine needles. It is deposited from alcohol in mammillary tablets. It fuses at 97°, and sublimes at higher temperatures. Ether and acetic acid dissolve it freely. Sulphuric and hydrochloric acid dissolve it with the aid of heat. Boiling nitric acid converts it into a new substance not yet analysed. Phenyl chloracetamide gave on analysis the following results :—

	Calculated.	I. Found.	II.
Carbon	50·73	50·11	50·08
Hydrogen	4·71	4·83	5·13
Chlorine	20·94	21·85	20·95
Nitrogen	8·26	8·01	8·42
Oxygen	15·36	—	—

Cresyl chloracetamide crystallises in prismatic needles which sublime at 110°, and melt at 162°. It is insoluble in boiling water. Sulphuric and acetic acids dissolve it slightly in the cold, but more freely when heated. It is insoluble in hydrochloric acid. Under the influence of nitric acid it is converted into a nitro compound. On analysis it gave—

	Calculated.	I. Found.	II.
Carbon	58·85	58·83	59·07
Hydrogen	5·11	5·62	5·57
Chlorine	19·34	19·16	19·14
Nitrogen	7·62	7·33	7·31
Oxygen	8·75	—	—

Dyeing Aniline Green on Wool.—Ch. Lauth.—This dye, unlike the majority of aniline colours, has but a feeble affinity for wool. When this fibre is dyed in a green bath without previous preparation, but a very slight amount of the colour is fixed. Some manufacturers have proposed to employ for this colour the alkaline process, which gives such excellent results for blues, but is with greens less certainly successful. The author's process is to prepare the wool in a bath containing a solution of hyposulphite of soda mixed with an acid or an acid salt. The sulphur suspended in the water becomes fixed upon the wool, and enables it to attract the aniline green. It is advisable to add to the mordanting-bath a small quantity of alum, or of a salt of zinc, the presence of which prevents the "tendering" of the wool. It is singular to see the action which the sulphur of the hyposulphites exerts upon this fibre. It becomes soft, loses its elasticity, and contracts considerably. This depends evidently on the penetration into the capillary tubes of the wool of that soft and viscid sulphur which is liberated from the hyposulphites. The singular property which sulphur in this state possesses of acting as a mordant for aniline green is not common to sulphur in all its modifications. Thus the solution of flowers of sulphur in the sulphide of carbon leaves wool completely incapable of attracting the dye. The same rule holds good, though to a less extent, with the polysulphides, which in all probability generally contain traces of hyposulphite. The mordant for aniline green is the insoluble electro-positive sulphur, as proved by the following experiment. When a sample of wool mordanted with hyposulphite is exhausted with sulphide of carbon, it loses nothing of its power of attracting and fixing aniline green; whilst another portion of wool saturated with the bisulphide of carbon which has served to extract the former, and which has been subsequently concentrated by distillation, takes up the colour no better than does unprepared wool. If the operation is carefully conducted, taking suitable proportions of hyposulphite, and of alum, or zinc-salt and acid, success is certain, and the wool is uninjured. It is scarcely needful to add that the wool must be previously cleansed from grease, and freed from all metallic contaminations by passing it through very weak hydrochloric acid. If this is neglected the shade may be saddened by the formation of metallic sulphides upon the fibre. The actual dyeing is performed in a solution of the green in hot water, raising the temperature to close upon 100° C. If yellowish greens are desired it is necessary to add to the bath some picric acid, and a salt capable of raising this colouring matter, which will only dye in presence of an acid. As on the other part the green does not dye in presence of acids a difficulty presents itself. This is overcome by the use of the acetate of zinc. This salt attracts the picric acid without injuring the green dyeing. If it appears that the green does not "work on" sufficiently a little acetate of soda may be added. With the aid of these two salts the dyer can produce blue or yellow shades of green at his pleasure, and can make use of his bath for an indefinite length of time. This procedure applies equally well to mixed goods of wool and cotton. After the wool is mordanted as above, the pieces are washed in sumach for an hour or more. The dyeing is then conducted in the ordinary manner, beginning at a low temperature. Or the wool may be dyed first, and the goods may then be sumached, and the cotton dyed in a cold colour-bath.

American Journal of Science and Arts, April, 1873.

Comparison of the Mean Daily Range of the Magnetic Declination and the Number of Auroras Observed Each Year, with the Extent of the Black Spots on the Surface of the Sun.—Prof. Elias Loomis, of Yale College.—This inquiry is an extension of one previously made by the author, and has been suggested by the publication of a new and very complete catalogue of auroras, by Prof. Joseph Lovering. For the relative extent of spots on the solar surface, Prof. Loomis takes the numbers furnished in Dr. Woolf's latest publications, and for the magnetic declination, the numbers obtained at Prague, as given in the *Vierteljahreschrift* and the *Beotacklunger Zutrag*. Lovering's catalogue of auroras embraces over 12,000 cases, extending from 500 B.C. to 1864. In selecting the data, some discrimination was necessary. The author excludes all observations from high northern latitudes, because the reports from these are only occasional; and also many from some lower latitudes, furnishing tolerably continuous accounts, as there was reason for thinking (he had already shown) the inequality of displays in these, in different years, consists more in unequal *brilliancy* than in unequal *frequency* of exhibition. The line drawn, however, is not arbitrary, but one denoting *equal auroral frequency* (as formerly determined). It

passes near St. Petersburg, Stockholm, the boundary between England and Scotland, and, crossing the Atlantic, follows the northern boundary of Massachusetts. The eastern boundary selected is 40° east of Greenwich, and the western 80° west. Observations from the southern hemisphere, from Asia, and from the western portion of the United States, are excluded (not forming a long series). Every known auroral observation within the above limits from the year 1776, when the magnetic observations commenced, is employed, and Lovering's list is completed as far as possible to the end of 1872, and otherwise supplemented. The catalogue is given *in extenso*, and the following table gives the total number of auroras for each year. To eliminate the effects of irregular and non-periodic causes, the average of the numbers in the second column is taken for each successive period of three years, and the numbers thus resulting are given in the third column:—

Number of Auroras from 1776 *to* 1872.

Year.	Aurora.	Mean.	Year.	Aurora.	Mean.
1776	39	—	1825	8	5
1777	81	69	1826	6	14
1778	88	97	1827	27	20
1779	123	91	1828	26	29
1780	62	94	1829	34	46
1781	97	83	1830	77	54
1782	90	92	1831	52	50
1783	88	76	1832	22	36
1784	51	65	1833	34	28
1785	55	83	1834	27	26
1786	143	112	1835	17	27
1787	139	139	1836	36	36
1788	135	131	1837	56	46
1789	118	112	1838	47	55
1790	82	93	1839	63	61
1791	79	76	1840	74	73
1792	66	56	1841	81	69
1793	23	33	1842	53	57
1794	11	14	1843	36	41
1795	9	8	1844	34	39
1796	3	9	1845	48	50
1797	15	6	1846	69	58
1798	1	8	1847	58	78
1799	7	5	1848	108	83
1800	6	6	1849	82	104
1801	5	6	1850	122	104
1802	8	8	1851	109	115
1803	10	10	1852	114	99
1804	12	15	1853	74	75
1805	22	15	1854	36	42
1806	11	13	1855	17	22
1807	5	6	1856	13	14
1808	3	3	1857	12	24
1809	2	2	1858	47	40
1810	1	1	1859	62	55
1811	0	0	1860	57	57
1812	0	1	1861	51	49
1813	2	4	1862	39	40
1814	9	5	1863	30	35
1815	3	5	1864	37	39
1816	3	6	1865	51	39
1817	11	11	1866	30	30
1818	18	14	1867	9	20
1819	13	12	1868	20	41
1820	5	7	1869	95	82
1821	3	3	1870	130	117
1822	2	2	1871	125	126
1823	0	1	1872	122	—
1824	2	3			

The auroral curve obtained from these average numbers shows great irregularities in the number of auroral exhibitions, but affords unmistakable evidence of a periodic alternation of seasons of abundance with seasons of scarcity. On comparing this curve with the sun-spot curve there appears a correspondence which is remarkable, though not so close as that between the magnetic curve and the sun-spot curve. In the dates of minima it may be said there is complete identity; in the maxima there is some discordance, which in 1840 amounts to three years. The critical parts of the auroral curve occur a little later than those of the sun-spot curve, and the auroral maximum is often more prolonged than the sun-spot maximum. Comparing the auroral curve with the magnetic curve the correspondence is greater, while the time of auroral maximum either coincides with the magnetic maximum, or slightly precedes it, the average difference amounting to about half a year. Prof. Loomis considers the fact of a true periodicity in auroral phenomena to be clearly established. He supposes the disturbance of the sun's surface, when spots appear, to be accompanied by a direct flow of electricity from the sun, which, travelling through the void celestial space, developes no light, but as soon as it encounters the earth's atmosphere (which appears to extend to the height of about 500 miles) it developes light, and its movements are controlled by the earth's magnetic force in a manner analogous to the influence of an artificial magnet upon a current of electricity circulating round it.

Notices of Recent Earthquakes.—Prof. C. G. Rockwood.

On some Points in Dynamical Geology.—Dr. T. Sterry Hunt.—The writer states that since 1858 he has been labouring to expand, complete, and give geological and chemical consistency to the suggestion long since made by Keferstein, and by Sir John Herschel, that the deeply buried and water-impregnated strata between the superficial crust of the earth and the solid nucleus constitute "a plastic material adequate to explain all the phenomena hitherto ascribed to a fluid nucleus." He notices several points in a recent essay, by Prof. Leconte, on the earth's crust; and considers that, by the contributions of Voze and Mallet, the theory of volcanic action, on the basis just referred to, is now well nigh complete.

Simple Device for Projecting on a Screen the Deflection of the Needle of a Galvanometer.—Dr. Alfred M. Meyer.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxi., No. 2, May 8, 1873.

Thermo Diffusion.—It appears to result from some experiments of Jedderson, published in *Pogg. Ann.*, that if a porous body is placed in the form of a diaphragm and exposed to differences of temperature on its two surfaces, a current of gas is set up from its cold to its hot side. The author considers this phenomenon as differing from ordinary diffusion, and proposes to distinguish it as "thermo diffusion."

Silica as Polishing Material.—M. Mignat, of Paris, proposes the use of hydrated silica in the state of impalpable powder instead of oxide of iron.

MISCELLANEOUS.

Public Analysts under the New Act of Parliament.—The practice of appointing medical men as Public Analysts, which is actually taking place, is beginning to bear grotesque fruit. For instance, the food analyst to one of the London Vestries has published his discovery that the caseine in unsophisticated cow's milk varies from 9·45 to 4·70 per cent, and in a sample of milk which was purchased he alleges that the solid contents of the milk amounted to 13·3 per cent, and that of these 8·4 consisted of caseine. The source of these wonderful discoveries will be obvious to chemists. It is ignorance of the fact that the fat is precipitated along with the caseine when milk is coagulated, and that in order to estimate the caseine correctly a thorough washing with ether is required. In the case of the 13·3 per cent of milk-solid

alleged to contain 8·4 of caseine, very nearly the entire fat must have been weighed with the caseine. This instance of official ignorance speaks volumes, and calls for the interference of the Government.

Soluble Glass in the Arts.—The employment of this substance in the arts is rapidly extending, and it has become indispensable in many industrial branches. It seems to be specially well adapted to the production of cements; when intimately mixed with fine chalk, it is found that a hard cement will be formed in from six to eight hours. With powdered sulphide of antimony, a black mass is produced, which is susceptible of taking a high polish, and possesses then a superb metallic lustre. Fine iron-dust gives a grey-black mass of great hardness. Zinc-dust gives a grey mass of much hardness, and having a metallic lustre. Zinc castings can be readily repaired by its aid.—*Journal of the Franklin Institute.*

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the production of colours for dyeing and printing. Edward Chambers Nicholson, Herne Hill, Surrey. October 19, 1872.—No. 3094. In the production of colours from aniline it is the general practice to employ what is known as arsenic acid, which when heated with aniline produces colouring matters which have as their base rosaniline. Now this invention relates to the substitution of arsenic acid in and for the production of colours from aniline of nitric acid and of hydrochloric acid, by the employment of which acids in conjunction with an excess of aniline and upon the application of a sufficient and prolonged heat, viz., of a temperature of about from 350 degrees to about 400 degrees Fahrenheit, to such mixture or combination, the desired colouring matters are produced. In carrying out my invention I take about 3 parts by weight of commercial aniline, such as is now generally employed for the production of red aniline dyes, and I add thereto about 1 part by weight of nitric acid of about the specific gravity 1420 and about 1 part by weight of hydrochloric acid of about the specific gravity 1160, the mixture or combination being contained in a boiler or other suitable vessel. I heat the same to a temperature of from about 350 degrees to about 400 degrees Fahrenheit until the conversion of the aniline and the compounds of aniline unto the desired colouring matters is effected, which result can be ascertained by occasionally testing the contents of the boiler. I have mentioned the temperature of about 350 degrees to about 400 degrees Fahrenheit as I find that the employment of such an elevated temperature is much more advantageous than the employment of a lower temperature, such for example as a temperature of 212 degrees Fahrenheit or the temperature of boiling water. Having effected the desired result, the contents of the boiler or other suitable vessel are removed and the colouring matters extracted therefrom by means of boiling water or other solvent, and the colouring matters thus separated may be either employed direct or may be subjected to purification, or the base, viz., rosaniline, may be separated therefrom by means of an alkali or of an alkaline earth as is well understood. I wish it to be understood that although I have given the proportions with which I have obtained good results I do not limit myself to such, as they may be modified.

Improvements in the treatment of substances capable of being employed for the purposes of dyeing and printing. Astley Paston Price, consulting chemist, 47, Lincoln's Inn Fields, Middlesex. October 19, 1872.—No. 3095. In the production of what is known as red aniline dyes from aniline, the method generally adopted is to heat together a mixture of aniline, or that substance which is known as commercial aniline and arsenic acid, until the desired colours are produced. The result thus obtained is known technically as the "melt," and the subsequent treatment or purification of the melt is generally conducted as follows:—The melt is digested in boiling water, and in some cases the solution is filtered and allowed to cool in order to separate what is known as arseniate of rosaniline and other compounds. The supernatant solution, or the original solution of the melt, is treated with lime in order to separate the arsenic and the arsenious acids which exist in the solution either in combination with rosaniline or with other colouring matters or otherwise. The liberated base, or what is known as rosaniline base, is then dissolved out by means of hot water, and is separated by crystallisation. By this process the arsenic and the arsenious acids are converted into arseniate and arsenite of lime, and thus rendered insoluble, and hitherto these products have been of no practical value. Now this invention relates to the treatment of the before mentioned product, or the result of heating aniline with arsenic acid and known as the "melt," in such a manner as that the arsenious and the arsenic acids contained in the solution of the melt shall be obtained in an available condition, and not as hitherto as a compound of lime possessing but little, if any, commercial value, and it consists in adding to the solution of the melt such an amount of ammonia or of ammoniacal liquor, as shall liberate the rosaniline base existing in such solution in the form of arseniate or arsenite of rosaniline. After allowing the base thus liberated to separate from the solution, the said solution contained in a suitable distillatory apparatus is submitted to the action of heat, either by applying heat externally or internally, or by the injection of a jet of steam, or otherwise. The compound of arsenic acid and ammonia is thus decomposed, and ammonia is liberated, which after having been collected may be again employed or otherwise utilised. The arsenious acid remaining in the solution may be separated therefrom by evaporation and crystallisation, or otherwise. In this manner the arsenious acid may be recovered in a condition capable of being re-converted into arsenic acid as is well understood. Any arsenic acid which had not been previously separated by crystallisation, as arseniate of rosaniline, will be found to be contained in the residual solution after having effected the decomposition of the solution of arsenite of ammonia by the employment of heat, and such arsenic acid or arseniate of ammonia may be separated either by evaporation or by evaporation and crystallisation.

Improved processes and apparatus for manufacturing compounds of pyroxyline or gun-cotton. William Robert Lake, patent agent, Southampton Buildings, London. (A communication from John W. Hyatt and J. Smith Hyatt, Albany, New York, United States of America). October 21, 1872.—No. 3101. This invention relates to the conversion and manufacture of pyroxyline or soluble cotton into a solid (which is herein denominated "celluloid") in accordance with a general process described in the Specification of Letters Patent, dated April 18th, 1871, No. 1025, to which Letters Patent reference is here made for a full description of the said process. This invention consists in the method or process of drying the prepared mixture of soluble cotton and camphor gum. In the process of manufacturing celluloid. In the process of dissolving or transforming pyroxyline. In the arrangement of a cold water jacket around the upper portion or receiving end of the heated converting cylinder. In the combination with a converting cylinder provided with a cold water jacket of a steam or hot water jacket. In the arrangement with the cold water jacket of the escape pipe of the hydraulic engine. In the arrangement with the upwardly projecting piston rod of the hydraulic engine and the supply and escape pipes thereof of two three-way cocks. In the arrangement in the discharge end of the converting cylinder of a central heating and distributing core; and in the combination with the hydraulic engine, converting cylinder, and celluloid discharge pipe of a mould and hydraulic clamp.

NOTES AND QUERIES.

Lard Oil.—Could you kindly inform me how to prepare lard oil? I have some few hundredweights of rancid lard I want to convert into oil.—J. WOOD.

Removing Stains from Paper.—Could any of your subscribers inform me how I can clean prints and engravings; also how can I remove the foxed or reddish-brown marks occasionally seen on some plates and paper.—SUBSCRIBER.

MEETINGS FOR THE WEEK.

MONDAY, 26th.—Geographical, 1 p.m. Anniversary.
TUESDAY, 27th.—Royal Institution, 3. Mr. J. H. Parker, "On the Archæology of Rome."
—— Civil Engineers, 8.
WEDNESDAY, 28th.—Society of Arts, 8.
—— Geological, 8.
THURSDAY, 29th.—Royal Institution, 3. Prof. Tyndall, "On Light."
—— Royal, 8.30.
—— Philosophical Club, 6.
FRIDAY, 30th.—Royal Institution, 9. The Earl of Rosse, D.C.L., F.R.S., M.R.I., "On the Radiation of Heat from the Moon, the Law of its Absorption by our Atmosphere, and its Variation in Amount with her Phases.."
SATURDAY, 31st.—Royal Institution, 3. Mr. J. Morley, "On the Historical Method."

TO CORRESPONDENTS.

W. Ripley Nichols.—The copies have been received, and one forwarded to Prof. Wanklyn.

R. Riley.—It is published weekly; S. Low and Co., Crown Buildings, Fleet Street, will procure it for you.

Goldsmith.—Pure hydrochloric acid will answer the purpose.

G. Procter.—The work is still in the press.

J. E. K.—See CHEMICAL NEWS, vol. xxv., pp. 166, 178, 242.

J. S. W.—There is no later edition of the work you mention; it is the best book you can have on the subject. A work on dyeing will shortly be published, which will also be useful to you.

BERNERS COLLEGE of CHEMISTRY.—EXPERIMENTAL MILITARY and NAVAL SCIENCES, under the direction of Professor E. V. GARDNER, F.E.S., &c. of the late Royal Polytechnic Institution and the Royal Naval College

The Laboratory and Class Rooms are open from 11 to 5 a.m., and and from 7 to 10 p.m. daily.

Especial facilities for persons preparing for Government and other examinations.

Private Pupils will find every convenience.

Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.

For prospectus, &c., apply to Prof. E. V. G., 44, Berners-street, W.

Extract from Analytical Report by WENTWORTH L. SCOTT, Esq., F.C.S., &c.:—"The simplest, safest, and most effective means for the 'preservation of animal substances.'"

Medlock & Bailey's Patent Bisulphite of Lime,

For the Preservation of Meat, Fish, Poultry, Game, and all other Animal Substances,

IN TEMPERATE OR TROPICAL CLIMATES, AND ON BOARD SHIP.

By the use of this valuable Preparation fresh Meat can be had throughout a voyage, however long, thus avoiding the expenses and losses incidental to the conveyance of live stock on board. No steamer or passenger ship should be without it, as it will enable captains to lay in provisions at foreign ports, wherever they are cheap and good, relieving them of the necessity of providing for the voyage home. It imparts no flavour to the meat, nor does it lessen its nutritive value, while it prevents scurvy and destroys contagion wherever it is used. For further particulars, see Descriptive Pamphlet, and also Opinions of the Press, both sent post free for seven stamps.

Extract from the "Times" Money Article of December 10, 1870.

"There was a trial of Preserved Meat from Rosario, in the Argentine Republic, in the City on Wednesday, with, it is stated, most satisfactory results. The preparation was effected by immersion in a solution of Bisulphite of Lime, according to the process of Messrs. Medlock and Bailey, of the Horseley Fields Chemical Works, Wolverhampton, and the meat was sealed up in a cask in the presence of Mr. Hutchinson, the British Consul at Rosario, on the 10th of August last, and brought by him to this country in a recent steamer. It had, therefore, been kept four months, and had made a passage across the Line, yet was found perfectly fresh, not only in quality, but in appearance, and was deemed by the persons present at the trial equal to any good ordinary home beef. Amongst these persons were merchants largely interested in the commerce of the River Plate, by whom an unqualified conviction has since been expressed that the problem of bringing unlimited supplies of animal food from distant regions will now prove to have been solved, the method being alike simple and inexpensive, and capable of being adopted under any circumstances. At the trial on Wednesday not the slightest flavour of any chemical or other artificial agent was detected."

The meat was cooked at SIMPSON'S, Bolt Court, Cornhill, and was partaken of by a number of influential gentlemen and merchants interested in the question, including M. B. Simpson, Esq., Consul-General of the Argentine Republic; Consul-General Neil, of Uruguay (copies of whose Official Certificates can be had on application), &c."

Extracts from a few of the communications lately received by the Patentees.

SIR JAMES MATHESON, Bart., M.P., *July 20, 1868, enclosing a further order*:—"Sir James Matheson is glad to tell Messrs. William Bailey and Son that their Bisulphite of Lime answered perfectly in carrying the carcases of a deer and a calf from Stornaway to London, *quite fresh*, being on the journey and voyage four days, during the very hot days of June; besides enabling the venison and veal to be kept twelve days after arrival by using the Bisulphite according to directions."

THOMAS J. HUTCHINSON, Esq., F.R.G.S., F.A.S.L., *Her Britannic Majesty's Consul for Rosario, Rio de la Plata*:—"When at Monte Video, I had the pleasure of tasting at breakfast a small piece of beef prepared by the Bisulphite of Lime, sent out to the Plate. It was given to me by Mr. Prange. The preservation of that meat was perfect, and it was the first piece of real juicy beef that I have tasted for the last seven years."

DR. STONE, *Health Officer, Trinidad*:—"I have found your Bisulphite of Lime of great value as a means of preserving meat."

THE GOVERNOR OF THE CITY POOR HOUSE, *Edinburgh*, "is very highly pleased with the results obtained from the use of your Bisulphite."

MR. J. W. SALISBURY, *Meat Salesman, of Newgate Market, London*:—"It is *a most valuable thing* for butchers."

MR. GEORGE BLACKMAN, *Butcher, of Newport Market, London*:—"I find Medlock & Bailey's Patent Preserving Liquid invaluable."

MR. GEORGE SCARLETT, *Butcher, of Notting Hill, London*:—"I believe there is nothing to be compared with your Bisulphite."

MR. ALEXANDER M'ALLISTER, *Fish and Game Salesman, of Glasgow*:—"By your Patent Process I have succeeded quite beyond my most sanguine expectations."

THOMAS SUTTON, Esq., B.A., *of Redon, France, August 27, 1868*:—"At last I have tried your Bisulphite of Lime, and I find it a grand success. We dined yesterday off a leg of mutton which I had preserved, and found it delicious—undistinguishable from fresh meat—no flavour of the Preservative—rich red gravy—no loss of weight. Every word is true that you say in your Pamphlet."

MESSRS. HOPER & SCHWERIN, *of Berlin, September 17, 1868*:—"We have much pleasure in informing you to-day that our success with meat as well as beer has been complete beyond expectation."

In addition to its remarkable powers in preserving animal substances from decay, MEDLOCK & BAILEY'S Bisulphite of Lime is also an absolute specific against epidemic Cattle Disease if used in accordance with the Patentees' instructions. It thus enables the Shipper to carry either "live or dead" meat in perfection without fear of loss in transit from the bad health of the one or the decomposition of the other."

Sole Manufacturers—Messrs. WILLIAM BAILEY & SON, Horseley Fields Chemical Works, Wolverhampton; and 2 & 3, Abchurch Yard, Cannon Street, London, E.C.

The GENUINE Bisulphite of Lime of Medlock and Bailey ONLY should be used. Price, 3s. 6d. per gallon, packages included.

Now ready, our New Revised

CATALOGUE OF CHEMICALS AND CHEMICAL APPARATUS,

Also

SCALE OF ANALYTICAL FEES,

Post Free on application.

PHILIP HARRIS & CO.,

Manufacturing Wholesale and Retail Chemists,

BULL RING, BIRMINGHAM.

Just Published, fcap. 8vo., limp cloth, illustrated, 2s. 6d. post free,

Practical Examples in Quantitative Analysis; forming a Concise Guide to the Analysis of Water, &c. By ERNEST FRANCIS, F.C.S., Demonstrator of Practical Chemistry, Guy's Hospital.

London: H. K. LEWIS, 136, Gower Street.

DEATH OF BARON LIEBIG.

RESPECTFUL NOTICE is given by LIEBIG'S EXTRACT OF MEAT COMPANY (Limited) that the Guarantee Certificate of Genuineness of Quality, signed hitherto by Baron Liebig and Professor Max von Pettenkofer, will in future, in accordance with Baron Liebig's own directions made many years ago, be signed by his Colleague, Professor Max von Pettenkofer, the eminent Chemist, and by Hermann von Liebig, son of Baron Liebig, who has been acting as his special assistant in the Analysis of the Company's Extract. Thus the excellence of the well-known standard quality of Liebig Company's Extract of Meat will continue absolutely unaltered.

Water-glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S, Ardwick Chemical Works, Manchester.

TO MANURE MANUFACTURERS.

The Lincolnshire Farmers' Association is desirous of receiving TENDERS for the supply of the PHOSPHATIC MANURE required by its Members during the next year. Several thousand tons of the Manure will have to be supplied; it must contain 26 per cent of soluble phosphate; and must be delivered (free of carriage) at the Depots of the Association at Grimsby, Gainsborough, and Sutton Bridge, either by sea or otherwise, and at Lincoln and Peterborough, in good, dry, and friable condition, for sowing by hand or with the dry drill.

Manufacturers willing to tender for the supply of the Manure at all, any, or either of the Depots, can obtain full particulars, as well as to the probable quantity required at each Depot, and the times and modes of delivery, as in all other respects, on application to me.

Tenders, addressed to the Chairman and endorsed "Tender for Superphosphate," must be sent in, under cover, to me not later than Friday, the 30th inst.

By order of the Committee,
C. E. BISSILL, Solicitor and Secretary.

Sleaford, 7th May, 1873.

N.B.—The Association does not bind itself to accept the lowest or any other tender.

Utilisation of Sewage and Purification of Streams.—The General Sewage and Manure Company, Limited, is prepared to Negotiate with the Authorities of Towns for the Treatment and Disposal of the Sewage of their Districts.—By order,

C. R. GIBB, Secretary.

No. 1, Crown Buildings, Queen Victoria Street, London, E.C.

SCIENTIFIC PRESENTS.—Collections to Illustrate "Lyell's Elements of Geology," and facilitate the important study of Mineralogy and Geology, can be had at 2, 5, 10, 20, 50, to 500 guineas; also single specimens of Minerals, Rocks, Fossils, and Recent Shells. Geological Maps, Hammers, all the recent publications, &c., of J. TENNANT, Mineralogist to Her Majesty, 149, Strand.—Private Instruction is given in Geology and Mineralogy by Mr. Tennant, F.R.G.S., at his residence, 149, Strand, W.C.

THE CHEMICAL NEWS.

Vol. XXVII. No. 705.

ON A NEW MODE OF FILTRATION.

By ISAAC B. COOKE.

The method of filtering, in which Bunsen has availed himself of Sprengel's water-air pump, is doubtless a great improvement upon the simple paper system: both in the time saved, and in the state in which the precipitate is left. But the pump is a comparatively costly apparatus, and not always suited to the position and circumstances of a private laboratory; and as the same, or nearly the same, effects can be produced by means which are in every chemists' hands, the plan here proposed may be convenient for some.

The needs of chemists have caused the manufacture of a special paper fitted for most of their filtering operations. But in some cases the texture is too coarse, and in some too fine. When a large sized filter is used the ash is too uncertain, and too great for nice quantitative operations. A small size requires constant and long-continued attention in order to pass through it even a reasonably small quantity of filtrate, together with the requisite washings.

In the process here advocated a quantity of carded cotton-wool; so small that the ash does not weigh 100 grs., and in commercial analyses may therefore be generally neglected, will suffice for any ordinary filtration; and a little experience enables the operator, by tight or loose packing, to adopt it to the coarsest or finest precipitate.

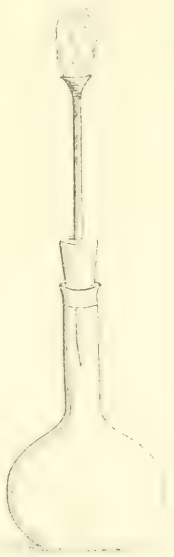
A glass flask, of not more than about 300 c.c. content, is fitted with a rubber stopper of soft and smooth surface, and of conical shape, so that the small end easily enters the neck of the flask; but the larger end cannot be forced in even under considerable pressure. Through the centre of the stopper a hole is bored to admit of a glass tube of about $\frac{3}{16}$ths inch internal diameter. The tube to be inserted should be about 6 inches long; one end being fused to a very small opening, and the other slightly enlarged in funnel form. About 1 inch of the nearly closed end of the tube is passed through the stopper, fitting tightly; and if an inch traverse the stopper 4 inches will be left outside when the stopper is in its place. Into the funnel-shaped mouth of the tube a small quantity of the carded cotton-wool is packed with the tapering end of a wire not having too sharp a point. The cotton-wool should be lightly pressed in at first until it occupies a length of about $\frac{1}{2}$ to $\frac{3}{4}$ inch of the tube, and then may be pressed more tightly at the mouth according to the quality of the precipitate to be filtered off, leaving a spreading brush of about $\frac{3}{4}$ inch length projecting from the end.

To put the instrument into operation a small quantity of distilled water is poured into the flask sufficient, but not more than sufficient, to quite cover the inner convexity of the bottom. The flask is then placed over the lamp till the water boils freely, and all air is expelled from the flask by steam. During the boiling the stopper should be placed in an inclined position, the short end of the tube resting against the inside of the neck of the flask, so as partially to close it, but leave space for the air and steam to rush out. Unless the mouth of the flask is thus partially closed during the boiling a much longer time is required to drive out the air; as if quite open a circulation takes place, cold air passing in at one side as steam is driven out at the other.

When steam issues freely past the sides of the stopper the flask may be taken from the lamp, and the stopper immediately pressed into its place and kept there by pressure until condensation begins. The flask is meantime inverted, and the tube with its brush of cotton-wool plunged into the fluid to be filtered, taking care that the wool is wholly submerged; as if any portion be left dry protruding from the fluid air will be drawn through it into the flask. As soon as the fluid is seen to be rising up the tube, the apparatus may be reared against a corner and left to itself.

The filtration will proceed with more or less rapidity in proportion as the cotton is packed lightly or solidly into the tube. When all the liquid has been drawn up, and the air is about to follow, a stream of distilled water from the wash-bottle may be driven upon the precipitate to wash it; and as the last portion of this also passes up the washing can be repeated, and again as often as is thought necessary. Lastly, the air following will leave the precipitate and the cotton-wool in a condition almost dry. The contracted orifice of the inner end of the tube secures it also free from fluid.

It is generally advantageous to perform the filtration from a small porcelain evaporating basin of about 2½ inches diameter, supported on a cork ring. The fluid and precipitate can be gradually poured and washed into



the basin as the process goes on. When it is completed the flask may be reverted, the stopper gently loosened, and the inner end washed by a stream from the wash-bottle into the flask. The cotton plug must now be carefully taken out by forceps over the evaporating basin, partially wiping the end of the tube in doing so with the clean portion of the plug, and the whole added to the precipitate. The forceps should be carefully wiped with a very small piece of cotton-wool, which may be further used with the forceps to complete the cleaning of the tube, and then also added to the precipitate. The basin after being rapidly dried over the lamp is ready for ignition. The precipitate cannot well be separated from the plug without loss; but there are few cases in which it will be injured by being ignited with the small quantity of cotton of which the plug consists, or, at least, in which that injury cannot be remedied by re-ignition after treatment with nitric or sulphuric acid. On cooling, the basin and its contents can be weighed, and, after brushing out the ash, the basin alone; the difference of course being the weight of the ignited ash.

A flask of 100 to 150 c.c. capacity is usually sufficient for a filtration; but it is not safe to use one larger than 300 c.c. unless it be of a spherical shape without the flat or concave bottom, as larger ones are not always proof

against the pressure. A spherical flask would be better also in respect of requiring a smaller quantity of water to drive out the air, and, therefore, also a shorter time to prepare it. In this case, however, if only a small part of the surface of the bottom is covered with fluid, care is required not to crack the flask during the boiling.

If the stopper be pliable, smooth, and well fitting, no air will pass between it and the neck of the flask during the operation. But the appearance of such leakage is stimulated by the renewed boiling of the fluid in the flask in consequence of the diminished pressure. Unless the fluid to be filtered has been boiled immediately preceding bubbles of air will constantly ascend the tube during the process. Yet the vacuum caused by the initial boiling will be so nearly completed that the filtration and washing may be continued if necessary till the body of the flask is nearly filled with fluid, and on reversion only a portion of the neck will be occupied with air.

When a flask is found unexpectedly not to be large enough to contain all the fluid required by the washing, it is better to suspend the filtration before the flask is full, and raising it out of the fluid to allow air to pass up the tube before reverting. The plug will then be in a dry state, and no portion of the fluid will run down the outside of the tube and be lost. Another flask in which the same stopper fits may be prepared by boiling, the tube inserted, and the filtration completed.

ON SOME IMPROVEMENTS IN THE MODE OF ESTIMATING AMMONIA BY THE "NESSLER" TEST.

By SIDNEY HARVEY.

The wonderful delicacy of the Nessler test when used for the detection and estimation of traces of ammonia seems to deserve a more exact method than that usually adopted, viz., the comparison of the depth of colour produced by this reagent in solutions of known and unknown strength in *glass cylinders* filled to a certain height.

Having been much engaged for some time past in the estimation of ammonia in waters, I have devised the following simple apparatus for its more exact and speedy accomplishment, and which answers its purpose remarkably well.

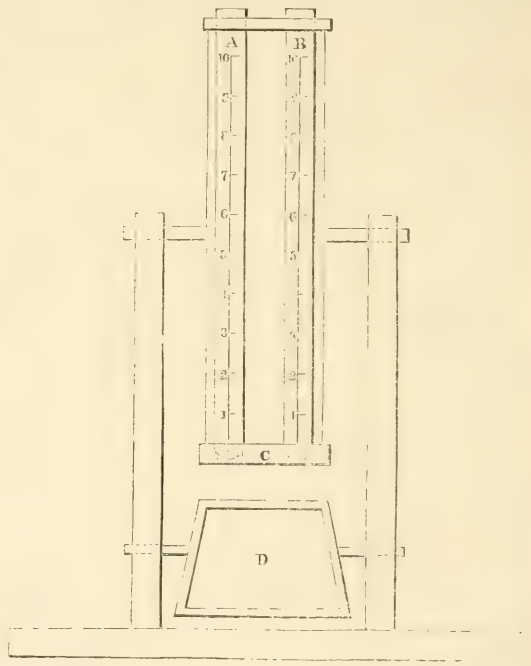
Two white glass tubes like test-tubes, but longer and of stouter glass, about ¾ inch internal diameter, and between 11 and 12 inches in length, are mounted upon a stand as shown in the sketch, and by means of pivots can be fixed either in a vertical position or swung to any convenient angle. These tubes are each divided by a paper scale or otherwise into inches in length, reckoning from the bottom, being graduated to contain 10 inches depth of fluid; they should also be marked respectively A and B. The cross-bar, C, should be perforated with two holes to admit the lower ends of the tube, which latter should be parallel, and not more than 1½ inches apart, reckoning from centre to centre. The holes should pierce the bar, and be contracted to ½-inch diameter at bottom. The under surface of the bar should be blackened; and below it in a convenient position should be fixed a small plate-glass mirror (D) about 5×3 inches, also swinging upon pivots.

To use this apparatus I proceed thus, dispensing altogether with the cylinders and stirring-rods:—I provide two stoppered flasks, each holding about 200 c.c., and marked respectively A and B. Into flask A I deliver a measured quantity, say 100 c.c. of the distillate (containing an unknown quantity of ammonia), add a proper quantity of Nessler test and shake. A trial solution, made by diluting a known number of c.c. of "standard" ammonia with pure water to exactly 100 c.c. also, is next introduced in flask B, Nessler added, and the mixture shaken. The apparatus, with the tubes in a vertical position, is placed near a window; the tubes filled up to the 10-inch mark with the solutions from the *respective* flasks, and then inclined towards the light at such an angle that by adjusting the mirror the operator looking close down upon the latter can see most clearly the reflection of the disc of colour. Should these discs agree in tint, the operation is over, and the estimation can be arrived at; but this is far from likely to be the result of a first trial, and here the use of the apparatus will be apparent. The column of *deepest* tinted liquid must now be *lowered* by returning it to its proper flask until the tints of colour as seen in the mirror exactly agree, and this can be done to the greatest nicety. The tubes are now replaced in a vertical position, and the height of the columns of liquid read off.

Now putting *a* for the height in inches of liquid in tube A, and *b* „ „ „ „ „ B, also *c* „ number of c.c. of standard NH_3 used in making the trial solution in flask B. The quantity of the latter in c.c. which *should* be used for the *next* trial solution is manifestly expressed by the formula—

$$C+\frac{b}{a}$$

The contents of tube and flask B may now be thrown out, and a second trial solution made in accordance with this



formula introduced into flask B, tested with Nessler, shaken, and tube B filled therewith as before. The discs of colour will now be found to agree very closely; so much so as to render a third operation needless, except in very precise investigations, when another adjustment can be made as before, and the new formula so obtained used for a fresh assay. The whole operation, after a little practice, will be found shorter and more certain than when cylinders are used, and is capable of a higher degree of accuracy.

A few words respecting the precautions to be observed when using the Nessler test may not be out of place. The quantity of "test" employed should be uniform. It should always be added *last*. No subsequent dilution of such mixtures with pure water should be allowed. Hence a liquid suspected to contain a comparatively large amount ammonia should be diluted to a known bulk previously

and a measured portion taken for testing. Solutions of too deep a colour are not so well compared as those of lighter tint: hence a limit to the length of the tubes employed, and which I do not think could be increased with advantage.

A very important question remains—How long after testing should the liquids "stand" before comparing colours? Messrs. Wanklyn and Chapman's invaluable little work upon "Water Analysis" recommends *ten minutes*. I do not find this time anything like sufficient; true, the *distilled* liquid containing NH_3 in the *free* state very soon comes up to full tint of colour after testing. Not so the *trial* mixture; very numerous experiments upon this point have convinced me that this latter is often half-an-hour, or little less in attaining its maximum of colour, and, therefore, comparisons drawn before this occurs would lead to too high results. I attribute this difference of time to the fact that the ammonia in the latter case exists as sulphate or hydrochlorate; and, moreover, in so dilute a state that even the large quantity of free alkali in the Nessler test does not liberate it fast enough. I have sought to remedy this when making a stock of "standard" chloride of ammonium by adding a portion of free KHO just before making up to exact measure, with, however, but partial success. As the problem for solution is the estimation of the ammonia which *really quits* the surface of the liquid in the retort used in the distillation, rather than that (however slight the loss) which ultimately reaches the receiving flask after condensation, it is a question whether the standard solution should not undergo the same ordeal by being distilled with alkali up to its exact original measure, and then *counted* to have lost nothing of its strength in the process. Trial solutions made with this latter would then contain NH_3 in the same state as it exists in that with which they are to be compared, and when tested would react as quickly with Nessler.

Canterbury, April 30, 1873.

ON THE CONDENSED EFFLUVE OF THE INDUCTION DISCHARGE.*

By M. Th. Du MONCEL.

The attention of chemists having lately been attracted to the effects produced by the condensed effluve of the induction discharge, I have thought it might be useful to communicate some facts connected with this physical phenomenon; the more so that some persons seem to confound the effects in question with those from the spark itself.

The electrical phenomenon to which I have given the above name is a sort of luminous discharge produced between two plates of glass, when these plates constitute together the insulating part of a condenser, the armatures of which are connected with the poles of a Rhumkorff apparatus. Thus, let one plate of window glass be separated from another by an interval of 2 or 3 millimetres; apply to their exteriors sheets of tin, or layers of liquid connected with the poles of the induced current, and you will obtain between the two insulating surfaces the electric effluve, which appears in the dark like a luminous rain, of bluish colour, and gives off ozone.

To obtain the phenomenon distinctly, the layer of air should be thoroughly dry; otherwise the discharge, instead of furnishing a homogeneous effluve, is concentrated in a small number of sparks of violet colour, which have not the properties of the effluve, properly so called; one of the most important of these being, that the discharge is finely divided over a large surface, and does not produce a heating effect nor sudden mechanical and disaggregating action. In virtue of this property one may electrise a gaseous body throughout its entire mass, avoiding the complex reactions which arise from the calorific and mechanical effects of the spark. And as the discharge takes place between two unattackable surfaces, we may obtain electro-chemical reaction without oxidations or volatilisations, or accidental absorptions capable of altering the nature of the products. By employing liquid layers as armatures, it is even possible (as M. Thenard has done) to follow by sight the effects successively produced.

At the time that I first made known to physicists this curious property of the induction discharge, of traversing glass without breaking it or illuminating the interior, some surprise may have been excited at such an electrical manifestation. But now that the numerous researches in England on the electric condensation produced in submarine cables have cleared up the question of electrical transmission through various bodies, there is no longer cause for this surprise. The phenomenon is explained by conceiving that, under the influence of condensation, the molecules of the insulating body become polarised after the manner of liquid molecules in electrolysis; so that they all conduce, individually and separately, to conducting the discharge from one surface to another of the glass plates. This is what the English have called *electrification*, and it is complicated by a momentary absorption of part of the charge; this absorption varying with the electrostatic capacity of the insulator. This subject is already well known, and I will only say here that it results from the mode of electrical transmission, and the insulating nature of the surfaces thus electrised, that the electrical charges not being capable of displacement from one point to another to take at the moment of discharge the path of least resistance, as in the case of metallic surfaces, the discharge cannot be concentrated in lines of air, but is forced to continue divided, except in the case in which the air-layer between the insulating surfaces is humid, when, these surfaces becoming conductive, the experiment is similarly conditioned to that of a discharge between two metallic surfaces.

The condensed effluve of induction may, in certain circumstances, present the curious aspect of stratified light (so well marked when the induction spark passes *in vacuo*). To obtain this, one of the plates should be slightly inclined upon the other, forming an acute angle. If one of the armatures is formed by a water-layer, kept in position by a border of mastic, the stratifications may be distinctly perceived; and they are made to disappear when the plates are restored to the parallel position. These stratifications are also observed when the space occupied by the effluve is broad and free of air.

The intensity of the electric effluve depends on the relative dimensions of the armatures and their polarity. It is a maximum when the smaller of the two armatures is positive. There is then seen about this armature a beautiful luminous radiation, and if the armature is cut so as to represent a silhouette, it stands out as a Chinese shadow on a luminous ground.

I will not dwell on the physical effects of the effluve, as these have been described at length in my notice on the Rhumkorff apparatus; but will simply point out that from an electro-chemical point of view, it may result from the difference of temperature between the effluve and the spark, that under certain conditions the one will act in the opposite direction to the other. Thus, from M. Jean's experiments, it seems demonstrated that ozone is only produced easily in atmospheric air at a low temperature, while at a high temperature the electrisation of the air causes the combination of its two constituent elements, a fact put beyond doubt by the experiments of M. Ed. Becquerel. It results, that according as we cause the effluve or the spark to act on an enclosed layer of air, we obtain ozone or hyponitric acid; and, in certain conditions, this difference of action may produce a combination or a decomposition. In the case of the spark traversing enclosed air, as in M. Becquerel's experiment, a combination is

* Abstract from *Comptes Rendus*.

obtained; but, on making the effluve react upon carbonic acid, as M. Jean did, this acid is decomposed into ozonized oxygen and carbonic oxide. In other cases the effects produced might be inverse, especially where the presence of ozone is necessary to determine a combination, as in a remarkable experiment by M. Thenard.

The foregoing facts prove clearly, then, that the mode of electrisation by the effluve is not at all the same as that produced by the spark.

The electric effluve has formed the subject of several important works, by MM. Grove, Thenard, Houzeau, Jean, Boillot, &c. I will here give some details (because they appear to have been forgotten) of certain curious experiments made by Mr. Grove, who, in 1856, succeeded in producing instantly, by means of the effluve on plates of glass, images similar to those of Moser. He placed between two glass plates, used for producing the effluve, a sheet of paper on which something was written, *Volta, e.g.*; under the influence of the effluve, the parts of the glass surface in contact with the lines of writing being impressed in a different manner from the other parts, it was sufficient on taking up the plate to breathe on its surface, in order to render visible an image of the writing; and by exposing to the vapours of hydrofluoric acid, an engraving on the glass was obtained.

For employing the effluve in electro-chemical experiments, two methods have been adopted. One consists in cementing together the two plates by their edges, allowing two tubulures for the entrance and exit of the gas: the other, in making the condenser with three tubes introduced one within the other, and so arranged that two of them enclose an annular liquid armature, surrounding at a distance of 2 or 3 millimetres the third tube, which contains the second armature. The former system has been employed by M. Jean, in his researches on ozone and carbonic acid; the latter, designed by M. Thenard, is the more perfect and practicable. The use of armatures of colourless liquid, besides affording facilities in watching the progress of the phenomenon, obviates the disruptive discharge which always occur with solid armatures at their contact with the glass, and which hinder the regularity of production of the effluve. These discharges are distinguished in the form of luminous lines, when one looks in the direction of the edge of the glass plates in this kind of condenser. In M. Boillot's apparatus, the armatures are of pulverised carbon, but I question if this acts so well as the liquid armatures.

ON GRAPHITE.

By J. STINGL.

To prepare graphitic acids the graphite employed must be freed from its ash constituents, for which purpose it is ground very fine, and treated with alkali at the point of fusion, aqua-regia, and hydrofluoric acid. The graphite of Ceylon is very difficult to purify. After being twice treated as above, there remained 0·42 per cent of an incombustible residue. A third operation reduced this to 0·12. Bohemian and Styrian graphite, purified as indicated, yielded mere imponderable traces of white incombustible matter.

Graphitic acid prepared according to the methods of Brodie and Gottschalk, from elutriated and purified Styrian graphite, is a fine yellow amorphous powder. Graphitic acid prepared from Ceylon graphite, from the so-called "Flintze" of the passan graphite, and from the graphite which separates out from crude soda-lye, appears, when examined under the microscope, to consist of foliaceous crystals. The graphitic acid from the Bohemian and Styrian graphite, when decomposed by heat, yields a black mass of great colouring- and covering-power, exceeding that of the finest lamp black. The residue from the graphitic acid obtained from the foliaceous graphites does not colour, and has no covering-power. The division of graphites into amorphous and foliaceous is therefore of great practical importance. When a lubricating or covering body is required, as in anti-friction compounds, in domestic black-leads, &c., the Bohemian, Styrian, and Austrian graphites are preferable. But for the manufacture of crucibles for metallurgical purposes the foliaceous graphite of Ceylon has the advantage..

In the determination of the carbon in graphite, the author recommends the procedure employed in organic analysis. If determined as loss after ignition the result is too high, if carbonate of lime, sulphide of iron, and hydrated oxide of iron.

MISCELLANEOUS.

Poisoning Case at Blackburn.—John Thomas Hall, chemist and druggist, of Church Street, Blackburn, has been summoned before the borough magistrates of that town on three charges:—Firstly, with having, on the 25th of January last, sold to Mary McGrath a cough-mixture composed of opium and adulterated with hydrochloric acid; secondly, with having, on the 10th of February last, sold to Superintendent Eastwood a cough mixture adulterated with hydrochloric acid; and thirdly, with having sold, on the same day, to Superintendent Eastwood half-a-pint of vinegar containing hydrochloric acid. Chief-Constable Potts stated that in February last a child named McGrath, eight weeks old, was poisoned by an overdose of cough mixture containing laudanum purchased of the defendant. The defendant denied all knowledge of the vinegar containing hydrochloric acid, and said he had bought it for pure malt vinegar from the Cambrian Vinegar Company, Leeds. At the assizes the grand jury expressed a hope, in which the judge concurred, that an investigation would be made as to where the vinegar was adulterated, and by whom. Chief Constable Potts afterwards visited Leeds, and procured various samples of vinegar in course of manufacture from the Cambrian Vinegar Company, other samples of vinegar supplied by the Company to retail dealers, and a sample from the defendant himself of the vinegar supplied to him by the Company before the poisoning case occurred. All these samples were submitted to Professor Farley, of Leeds, and to Professor Railton, of Blackburn, for analysis, and they found all the samples free from hydrochloric acid or other deleterious ingredients. Evidence having been given corroborative of these facts, the Mayor, in imposing a fine of £5 and costs upon the defendant, said that the Cambrian Vinegar Company were exonerated from all blame.

Paper in the Boston Fire.—Curious results followed some of the experiments made upon charred papers and documents, and the examination of books in safes which proved worthless in the great fire. It was found that what paper makers call poor paper, paper considerably "clayed," stood the test best. Parchment paper, used for bonds and legal documents, shrivelled up exceedingly, and the print blistered so that it could be read when writing was illegible. So it was with the engraved work on notes. The gilding on the account books burned and charred showed out as bright and as clear as when the books were new, which brings up the question if to introduce gilt-edged account books would not be well, on the ground that the gilt would stay the passage of fire to the pages within. Books crammed into a safe so that it was difficult to get them out, suffered considerably less than those that were set in loosely, and in some cases came out from safes, in which everything else was worthless, so far preserved that the figures on their pages could be deciphered. With charred papers, which could not be made transparent by any light whatever used, it was found, after the employ-

ment of vitriol, oxalic acid, chalk, glycerine, and other things, that anything that moistened them to a certain stage—to which it was delicate work to get and not to pass—made the lines, words, and figures legible through a magnifying glass. It has been the almost universal experience that lead pencil marks show out all right where ink marks cannot be distinguished. The success of the use of photography has already been noted.—*Boston Advertiser.*

A New Experiment.—Mr. Elihu Thompson has made the observation that tin-foil, if wrapped about a few crystals of chlorate of potassa, can be made to detonate loudly upon being struck smartly with a hammer upon an anvil, or in a mortar. The phenomenon being precisely analogous to the well-known experiment of triturating sulphur and the chlorate. To the best of our knowledge the observation that such metals as tin can be oxidised in this way is a new one and worthy of notice.—*Journal of the Franklin Institute.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Annalen der Chemie und Pharmacie, band clxvii., heft 1, May 6, 1873.

On the Air contained in Sea-Water.—Oscar Jacobsen.—An interesting, but lengthy paper. The proportion of carbonic acid appears to be very variable, and at great depths, *e.g.*, 2000 fathoms, may exceed 30 per cent. Its amount seems connected with that of the saline matter. It cannot be considered as a free absorbed gas, like the oxygen and nitrogen, and can only be very imperfectly expelled by ebullition continued for an hour. An elaborate table is appended, showing the depth, the temperature, the percentage of saline matter, the amount of carbonic acid by weight and volume in a litre of water, and the respective proportions of the oxygen and nitrogen.

Oxidation of Allantoin by means of Ferricyanide of Potassium.—F. C. E. van Embden.—Some time ago, Mulder attempted to determine more closely the nature and formation of the lantanuric acid described by Schliesser. The view that this acid, along with urea, is formed from allantoin by combination with water is doubtful. He therefore attempted to obtain lantanuric acid by acting upon allantoin with ferricyanide of potassium and caustic potassa. A body distinct from Schliesser's lantanuric acid was the result. The author has made an examination of this substance. 4 grms. of allantoin were dissolved in potassa of sp. gr. 1·1, and ferricyanide gradually added. The colour produced on each addition disappears rapidly at first, but subsequently more slowly. More alkali was added from time to time. Ammonia escaped. The crystalline deposit of ferrocyanide formed was redissolved by the addition of a little water. When the colour ceased to disappear (which required about 16 grms. of ferricyanide), the liquid was slightly acidulated with acetic acid; the crystalline precipitate was filtered off, pressed, digested with a little water, and pressed again. It forms then a white mass which, by re-crystallisation, can be obtained in white, silky needles. The aqueous solution has an acid reaction. Neutral acetate of lead throws down a heavy white precipitate, gelatinous at first, but subsequently crystalline, soluble in excess of the precipitant, but re-precipitated on the addition of ammonia. Basic acetate of lead gives a similar precipitate, likewise soluble in the neutral acetate. Nitrate of silver yields a white precipitate easily soluble in acetic acid and in ammonia. Baryta-water gives a white gelatinous precipitate, insoluble in hot or cold water, but easily soluble in acetic acid. On desiccation at 100° C., or over sulphuric acid, there was no loss of crystalline water. The composition of these crystals is—

Carbon	24·40
Hydrogen	1·02
Nitrogen	21·40
Potassium	20·07

corresponding to the formula $C_4N_3H_2KO_4$. It may be regarded as the acid potash-salt of an acid $C_4N_3H_3O_4$, which the author proposes to name "allantoxanic acid." The same acid can be formed by the oxidation of allantoic acid ($C_4N_4H_8O_4$) in a similar manner. Its production can be represented by the formula—

$$C_4N_4H_6O_3 + O = C_4N_3H_3O_4 + NH_3.$$

Action of Sodium-Amalgam upon Dinitro-Hephthylic Acid.—H. A. Kullhem.—The author obtained dinitro-hephthylic acid by the prolonged action of nitric acid upon camphor. He has now exposed this acid to the action of nascent hydrogen, and obtained a new mono-nitro acid. The new acid dissolves easily in water, alcohol, and ether; it fuses at 115° to 116° C., and is volatilised below 100° C. Its composition is—

Carbon	44·72
Hydrogen	6·83
Nitrogen	8·70
Oxygen	39·75
	100·00

corresponding to the formula $C_6H_{11}(NO_2)O_2$.

Products resulting from the Decomposition of Glyceric Acid by Chloric Acid.—MM. Werigo and Okulitsch.—This paper does not admit of abstraction.

History of the "Sprengel Water-Pump."—H. Sprengel.—A short controversial note.

A New Acid Obtained from Aloes.—P. Weselsky.—Aloes, according to Hlasiwetz, yield, when oxidised by fusion with caustic potassa, para-oxybenzoic acid and orcin as main products. When, however, large quantities of aloes are used (*e.g.*, 20 lbs.), it is possible to isolate a third product: this is an acid hitherto unknown, closely connected with orcin, and further interesting on account of its isomerism with certain well-known acids. It is distinctly crystalline, and affords highly characteristic reactions. It was obtained as follows:—The aloes, socotrine, were melted in a roomy iron pan, in quantities of 2 lbs. at a time, with 3 parts of crude caustic soda till the phenomena indicated by Hlasiwetz made their appearance. The solution of the various melts was acidified with dilute sulphuric acid, filtered, and agitated with ether. After the ether had been shaken off, and the bulk of the para-oxybenzoic acid had been removed by crystallisation from the residue after evaporation to the consistence of a thin syrup, the mother-liquor, still containing orcin, the residue of the para-oxybenzoic acid, the new acid, much acetic acid and tinctorial products of decomposition, was dissolved in water and mixed with acetate of lead. The precipitate which falls contains chiefly the last-mentioned bodies. It is removed, and the filtrate is freed from lead by means of sulphuretted hydrogen. Hereon the acid liquid is saturated with carbonate of baryta, in order to separate the orcin from the acids. After this treatment the liquid is

again agitated with ether, and the orcin is obtained from the ethereal extract. The aqueous barytiferous liquid is now mixed with dilute sulphurous acid, the sulphate of baryta is filtered off, and the filtrate again agitated with ether. After the ether has been expelled the bulk of the remaining para-oxybenzoic acid crystallises out of the residue. The strongly acetic mother-liquors (A) congeal on standing to a granular crystalline paste, which, when pressed and re-crystallised from hot water, yield fine round verruciform crystalline groups, consisting of minute radiating needles. After bleaching with animal charcoal, the substance becomes colourless, and its crystalline form has a strong resemblance to that of gallic acid. This substance is the new acid; the whole yield did not exceed 30 grms. The analysis of the substance dried at 100° C. leads to the formula $C_9H_{10}O_3$. The acid is capable of distillation, when a faintly coloured oil is obtained, which soon congeals in crystals. The anhydrous acid, $C_{18}H_{18}O_5$, dissolves slowly in boiling water, and is gradually re-converted into the hydrous acid, $C_9H_{10}O_3,H_2O$. This change is more rapid in presence of alkaline carbonates. The formula $C_9H_{10}O_3$ corresponds to eight known acids—the melilotic, hydroparacumaric, phenyl-lactic, xyletinic, oxymesitylenic, phloretinic, isophloretinic, and tropasic. It is, however, not identical with any of these acids, as its properties show. It is sparingly soluble in cold, but completely in boiling, water, and crystallises out, on cooling, in long voluminous needles concentrically grouped. Its taste is faintly acid and slightly astringent. In ether and alcohol it dissolves readily. The melting-point of the air-dried acid is about 97° C., but, when dried over sulphuric acid *in vacuo*, it melts at 115° C.; when anhydrous, it melts at 138° C. If heated between two watch-glasses it sublimes in light shining leaflets, like benzoic acid. When heated, it diffuses an odour like cumarine, fuses, and congeals in a crystalline state. It burns with a luminous smoky flame. The aqueous solution is not coloured by perchloride of iron. If rendered alkaline with any base, the liquid takes, on exposure to the air, an intense and characteristic cherry-red. The hypochlorites turn the solution a splendid purple-red, which disappears again on the addition of excess. The neutral solution reduces nitrate of silver at a gentle heat. If heated with Trommer's liquid, suboxide of copper is deposited. The dilute solution is not precipitated by dilute acetate of lead; an acid acetate gives a white precipitate, which gradually becomes red. The solution readily decomposes the metallic oxides; only the salts of barium, calcium, and copper have been examined. The behaviour of the new acid with fusing potassa throws most light upon its constitution; if heated therewith in the proportion of 1 : 3, until hydrogen gas is freely evolved, it is decomposed, the products being orcin and acetic acid, both of which can be isolated and separated in the known manner. To remove all doubt, the orcin thus obtained was purified and submitted to analysis; the decomposition, therefore, may be thus expressed—

$$C_9H_{10}O_3 + H_2O = C_7H_8O_2 + C_2H_4O_2.$$

According to this behaviour it is probable that the acid is closely related to evernic acid, which yields also orcin, and consists of $C_9H_{10}O_4$. It is also plain that the acid is isomeric with mono-acetyl-orcin. The author proposes the name alorcinic acid. We may suppose that alorcinic acid is one of the first transformation products of aloes on fusing with potassa, and that the orcin obtained results from a further decomposition of this acid.

Addition of Cyanamid.—Dr. E. Baumann.—An examination of the behaviour of cyanamid with various compounds containing the group (NH_2), in order to aid in determining the constitution of creatin and glycocyamin, and to obtain further bodies belonging to the same series.

Examination of certain Alkaloids.—Dr. Weidel has succeeded in obtaining from alkaloids well-defined oxygenated compounds, free from nitrogen, which will probably throw a new light on the constitution of these important bodies. This result has been already obtained with cinchonine, berberine, and veratrine, and it would seem that all true alkaloids behave in a similar manner. The preliminary experiments are most advanced with cinchonine, which, when oxidised in a peculiar manner, yields two azotised compounds, one of which has an acid nature, forming definite crystals and finely crystallised salts. This acid, on treatment with nascent hydrogen, gives off its nitrogen as ammonia, and is transformed into a non-azotised strong tribasic acid, also crystalline, and which, in its general properties, strongly resembles certain vegetable acids. The second compound produced during the oxidation of cinchonine is also crystallisable, but requires further study. Cinchonine, $C_{20}H_{24}N_2O$, appears to include two atomic groups, the one containing C_{11}, and the other C_9. The former acid, whose nitrogen is capable of elimination, appears to be derived from the group C_{11}.

Isomeric Dinitrophenols.—H. Huebner and Werner Schneider.—Reserved for full insertion.

Nature of a Sulpho and Sulph-nitro-bibrombenzolic Acid.—By H. Huebner and R. Douglas Williams.—This paper examines in how far the sulphoxylic group has a tendency to render the bromine in a benzol compound replaceable. The investigations of Engelhardt and Latschinoff (*Zeitschrift fur Chemie*, 1870, 230) have shown that the chlorine in bichlorbenzol is not made so far replaceable by the admission of a nitro group that bromine can be readily substituted when the compound is boiled with potash lye at ordinary pressure. It was then conceived to be possible that the sulphoxyl group along with a nitro group might convert bibrombenzol (which is closely analogous to bichlorbenzol) into a decided poly-basic acid. Experiment showed that the sulphoxylic group has very little influence upon bromine.

Synthesis of Carbazol.—By C. Graebe.—The author has previously announced the fact of this synthesis. Aniline was slowly conducted through a porcelain tube maintained at full redness. A shining charcoal is deposited, whilst a liquid distillate collects in the receiver, and hydrogen, hydrocyanic acid, and ammonia are evolved abundantly. The distillate was treated with hydrochloric acid to dissolve unchanged aniline and a liquid base, which boils at a higher temperarure. The residue was extracted with alcohol. The alcoholic filtrate yielded on sublimation, after evaporation to dryness, foliaceous crystals, partly coloured, and partly colourless, and possessing the properties of impure carbazol. On combining it with picric acid, red crystals were obtained, which in form, colour, fusion-point (182° C.), and solubility agreed completely with the carbazol-picric compound described by the author and Glaser. The carbazol thus obtained fuses at the correct point (238° C.), crystallises from alcohol and benzol in white scales, and agrees in solubility with the carbazol from coal-tar. It displays the characteristic behaviour with sulphuric acid, in which it dissolves with a yellow colour, which, on the addition of nitric acid, passes into an intense green. Carbazol is therefore found, though but in small quantity, among the products formed when aniline is passed through an ignited tube. It is also obtained by passing diphenylamin very slowly through a porcelain tube heated in the same manner.

On Phenanthren.—By C. Graebe.—This long and important paper is reserved for full insertion.

New Production of Tetrabromide of Carbon from Bromoform.—By J. Habermann.—Hlasiwetz has remarked that when bromoform remains in contact with bromine in excess, and with an alkaline lye, it is frequently in course of time converted into a solid tetrabromide of carbon. The author has since determined the conditions of this change. The agency is light. In a series of experiments 20 grms. of bromoform and 13 grms. of bromine were placed in contact, and covered with dilute potassa lye. Several flat-bottomed bottles of white glass, containing this mixture, were exposed to direct sunshine,

others to diffused light, and others were placed in the dark. In the bottles exposed to direct sunlight the whole of the bromoform had disappeared, and a crystalline mass of tetrabromide of carbon had taken its place in five to six days. In those placed in diffused light the same change occurred in double the time, whilst in those kept in darkness a mere trace of the tetrabromide could be found after the lapse of three months. The transformation of bromoform in CBr_4 takes place as follows:—

$$CHBr_3 + Br_2 + KHO = CBr_4 + KBr + H_2O.$$

The potassa lye can be replaced by water. Bromoform mixed with bromine, and covered with water, is slowly converted under the influence of light into tetrabromide of carbon, with formation of bromide of hydrogen.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Mène, No. 18, March 6, 1873.

The Manure of Agen and the Phosphates of the South.—A description of the manure works of M. Jaille, at Agen, on the Garonne.—Animal matters, such as horns, hoofs, blood, wool, leather-waste, &c., are carefully freed from extraneous impurities, and are then steamed at pressures varying from 11 to 15 atmospheres. By this treatment they are disaggregated, and sometimes liquefied. They are then removed from the cylinders, dried, powdered, and used in compound manures. The phosphates are obtained from the department of Lot. They are finely powdered, and are then mingled with an equal weight of sulphuric acid at 52° B. (about 1·57 sp. gr.) in order to convert them into superphosphate. We remark, with surprise, that M. Jaille does not manufacture his own sulphuric acid. The compound manures contain 45 to 50 per cent of superphosphate along with the nitrogenous powder above mentioned, and certain quantities of sulphate of ammonia and alkaline nitrates. The manure shows, on analysis, 7 to 10 per cent of nitrogen, 25 to 30 of soluble phosphate, and 1 to 3 of potassa. It is sold at 25 francs for 100 kilos., or about £10 per ton, a price which it is amply worth if the composition be as stated above. It is generally applied to the land to an extent of 400 to 500 kilos. per hectare. Any portions of the animal matter which resist the action of steam are set aside and used in the composition of special manures for vines.

Moniteur Scientifique, du Dr. Quesneville, May, 1873.

Products Derived from the Reaction of Bibromide of Ethylene upon Aniline and Toluidine.—A. Gretillat, of Rio Janeiro.—An important paper which does not admit of useful abstraction.

Aeration of Wines during Fermentation.—Dr. Ott.—A valuable contribution to our knowledge concerning the influence of certain low vegetable organisms upon fermentation. It appears that in white wines the principal fermentation is begun by a fungus named *Saccharomyces apiculatus*, and is continued subsequently by *S. ellipsoidens*. Other fungi play a secondary part. The germs of these ferments are found in larger or smaller quantity adhering to the grapes.

Study on the Alkaloids of the Cinchonaceæ.—D. Hesse.—An exhaustive paper which we hope to transfer to our columns *in extenso*.

Separation of Toluidine and Pseudo-Toluidine.—Dr. Bindschedler, of Basle.—Dalsace Bros., of Paris, sell a special heavy aniline, boiling between 198° and 202°, and containing little except toluidine and pseudo-toluidine. In acetylising this heavy aniline it was found to yield solid and crystallisable aceto-toluidine, corresponding in amount to a mixture of 70 per cent pseudo-toluidine, with 30 of crystallisable toluidine. The following process may be adopted for the isolation of pure pseudo-toluidine:—Dissolve 2500 grms. of oxalic acid in 25 litres of boiling water, adding afterwards 6 litres of commercial hydrochloric acid at 20° B. Into this mixture 10 kilos. of the heavy aniline are slowly poured. The whole is boiled up again, and constantly stirred whilst it cools down to 60° C. It is then rapidly filtered through flannel to separate the crystalline deposit. This is pressed, ground up with a little cold water, and pressed again. On decomposing it with caustic soda and distilling, crystalline toluidine is obtained, fusing at 45° C. To the filtrate we add, with constant stirring, 2 kilos. of oxalic acid, which determines a further crystalline deposit. This consists of a mixture of oxalates of toluidine and pseudo-toluidine, which, from its richness in the former, serves to prepare a further quantity of that base. The mother-liquors from this second crystallisation, completely cooled after filtration, are tested with a concentrated aqueous solution of oxalic acid. The mixture is strongly agitated, and if no further crystalline deposit is formed (in which case it must be filtered again) an excess of caustic soda is added, and the whole submitted to distillation. The oily layer which floats on the condensed water is drawn off, rectified, and is a pseudo-toluidine sufficiently pure for all industrial uses, as it contains mere traces of aniline and toluidine.

Revue Scientifique de la France et de l'Etranger, No. 45, May 10, and No. 46, May 17, 1873.

These numbers contains no chemical papers.

Gazzetta Chimica Italiana, Anno III. 1873, Fascicolo III.

On Certain Derivatives of Benzylated Phenol.—E. Paterno and M. Fileti.—The action of the chloride of acetyl and of sulphuric acid upon benzylated phenol is particularly studied.

Examination of the Scientific Principles of the Art of Dressing Hides.—A. Reimer.—In this memoir the author examines the action of pure water, of lime-water and other alkaline liquids, of potash-alum, and of common salt.

Refractive Power of Saline Solutions and its Modifications.—C. A. Valson.

Fascicolo IV.

On Certain Properties of Gypsum.—Alfonso Cossa.—The author studies the solvent action which gypsiferous waters exert upon different rocks.

On the Apparent Variability of the Law of Dulong and Petit.—G. Hirn.—A physico-mathematical paper.

Experiments on the Cultivation of the Sugar-Beet, made in the Year 1872, at Grotta Rossa, in the Campagna of Rome.—F. Sestini and G. Del Torre.

Experiments on Vinification by the Method of Chaptal.—L. Moschini and F. Sestini.—This process consists in the addition of a certain quantity of powdered marble during fermentation. The results appear to have been—an increase of alcohol, amounting in one instance to more than 2 per cent; a decrease of extractive matter; a decrease in phosphoric and sulphuric acids, and in chlorine.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxi., No. 3, May 15, 1873.

Diamonds in the Sands of California.—Professor Silliman having received from Mr. Trendwell, of San Francisco, a small parcel of the sand resulting from the hydraulic treatment of ores, found, on examination with the microscope, that they abounded in fine colourless zircons of the form of those of Expailly, along with crystals of topaz, fragments of quartz, grains of chromic acid (chrome-iron?) and titanic acid, and globular bodies of a very high refractive power, which he believes to be diamonds. Mr. J. Torry, in a single sample of the sands washed from the gold ores of Nicaragua, found twenty mineral species, some of them very rare.

No. 4, May 22, 1873.

Distillation by Cold.—At a recent session of the Berlin Chemical Society Prof. Smée proposed a method for detecting organic matters contained in the air, and for effecting at the same time a kind of distillation by cold. A glass funnel, closed at its narrow end, is held suspended in the air and filled with ice. The moisture of the air is condensed in contact with the exterior surface; it trickles to the bottom of the apparatus, and falls into a small basin placed for its reception. The liquid obtained in a given time is weighed. It generally contains ammonia, which is determined by known methods. Distillation by cold may be employed for separating volatile substances which might be injured by heat. Thus if flowers are placed under a large bell-glass along with the refrigerating funnel, a liquid is obtained in the basin saturated with the odorous principles of the flowers.

Journal für Gasbeleuchtung und Wasserversorgung, Nos. 2, 3, 4, 1873.

These only contain papers relating to gas- and water-works engineering and management.

No. 5.

Sal-Ammoniac in the Hydraulic Main.—R. Gasch.—While the hydraulic main of the gas-works at Dresden was being cleaned a large quantity of a whitish-coloured saline mass was met with, mixed up with the inspissated tar. At first this saline matter was taken to be bicarbonate of ammonia, but on being chemically tested the salt was found to be chloride of ammonium. The author found that the salt is derived from the Zwickau coals, which (see CHEMICAL NEWS, vol. xxvi., p. 226) contain a considerable quantity of common salt. Sal-ammoniac is now a regular by-product of the Dresden gas-works.

Nos. 6 and 7.

These only contain matter relating to gas- and water-works engineering and management.

Bayerisches Industrie und Gewerbe-Blatt, February, 1873.

Soldering of Iron and Steel.—Ph. Rast.—So-called German silver may be applied to soldering steel to iron and iron to copper. Borax should be used as a flux, and the German silver granulated as is done for hard brass solder.

Gilding of Iron.—W. Kirchmann.—Sodium amalgam is first applied to the iron, which is hereby readily coated with mercury. Next a concentrated solution of chloride of gold is applied to the mercurially coated surface; and lastly, the object is strongly heated, either in a muffle or in the flame of an enameller's lamp.

March and April.

These contain no articles relating to chemistry.

Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, No. 3, 1873.

Solubility of Saline Mixtures.—F. Rüdorff.—In the introduction to this first portion of an exhaustive monograph a *résumé* is given of the labours of Gay-Lussac, H. Kopp, C. J. B. Karsten, G. J. Mulder, and C. v. Hauer, on this subject. The author then treats on the solubility of saline mixtures—(1), of such salts with which a chemical decomposition cannot take place, salts containing either the same base or the same acid; (2), saline mixtures which admit of double decomposition, salts therefore containing either two bases or two acids.

Bulletin de l'Académie Royale de Belgique, No. 1, 1873.

Note on Shifting Instantaneous Axes and Central Axes in a Solid Body in Motion.—M. de Tilly.—These notions, which in most treatises on kinematics, are preceded by a large number of preliminary propositions, the author seeks to establish in a more simple, *a priori* manner.

Note on a Singular Configuration of Spots on the Planet Mars, observed by P. Secchi on 18th Oct., 1862.—Dr. F. Terby.—In comparing P. Secchi's drawing of the appearance of Mars on that occasion with those by Mr. Lockyer, from observation made only 36 minutes later, Dr. Terby remarks on the round dark spot with luminous ring, represented in the former only, and which Secchi supposed to be from a cyclonic movement on the ocean of De La Rue. It has been thought that a shaded part extending outwards from beyond the ring, in Secchi's drawing, corresponded to the sea of Lockyer. But Dr. Terby gives reasons for considering Secchi's round spot itself as the sea of Lockyer, while the other just mentioned is more likely the sea of Maraloi, appearing also also in Lockyer's drawings. Dr. Lassell's and Lord Rosse's drawings give certain details which vaguely recall the drawing by P. Secchi, the sea of Lockyer being surrounded by a luminous ring.

No. 2.

This number contains no articles which call for notice.

No. 3.

On Man considered in the Social System either as a Unit, or as a Fragment of the Human Species.—M. Ad. Quetelet.—The author explains the general nature of his researches towards construction of a system of "Social Physics." In a table at the end he furnishes statistics of chest measurements on about 1,500 American soldiers, and compares these with measurements obtained by calculation from certain data; finding a close correspondence.

Researches on the Etherised Derivation of Alcohols on Acids (On Methylenic Mono-Cyanhydrine, $HOCH_2+CN$).—The author suggests that this product might be obtained by the reaction of anhydrous hydrocyanic acid on the formic aldehyde, or oxide of methylene, CH_2O. Not having been able to attempt this, he sought to fill the gap in the group of methylenic and glycollic derivatives by realising one of the corresponding alcoholic derivatives $(C_nH_{2n+1}O)CH_2+CN$; and with this view he produced *ethyl-glycollic nitrile*, $(C_2H_5O)CH_2+CN$; by reaction of phosphoric anhydride or pentachloride of phosphorus with ethyl-glycollamide—

$$(C_2H_5O)CH_2+COH_2N.$$

It is a mobile colourless liquid, with an agreeable ethery odour; density at +5° is 0·915; boiling-point, at atmospheric pressure, 134°–135°. In this product he finds an illustration of the remarkable stability of oxyalcoholic combinations, methoxyle, CH_3O, ethoxyle, C_2H_5O, &c.; with regard to agents, such as chlorides, bromides, &c. of phosphorus, phosphoric anhydride, &c., which so readily attack the equivalent and corresponding hydroxyle grouping HO. He gives several examples of transformations and combinations he had succeeded in realising with these polyatomic compounds, by virtue of this property.

Annales de Chimie et de Physique, April, 1873.

Nitrification of Humus.—J. Boussingault.—The author calls attention to the spontaneous formation of saltpetre in many parts of Algeria, Spain, Hindostan, South America, and other localities. The chief portion of this memoir is, however, devoted to the discussion of the origin and mode of formation of the saltpetre in arable soil, and more particularly in soil containing decaying organic matter. From the author's researches, it appears that (1) the nitrification, even under the most favourable conditions, is a slow process; (2) that in the nitrification of humus, when proceeding in a confined space (under a bell-jar, for instance), the nitrogen of the air does not contribute to the formation of nirtic acid; (3) that, as a

rule, the process depends upon the organic matter present in the humus, and in all fertile soil, but is promoted by the presence of certain bases.

Studies on Valerianic Acid.—I. Pierre and E. Puchot.—The contents of this memoir may be summarised as follows:—Valerianic acid, obtained by the oxidation of amylic alcohol, and concentrated, boils at 178°. At 760 m.m. barom. the sp. gr. of this acid is—at 0° = 0·947; at 54·65° = 0·8972; at 99·9° = 0·8542; at 147·5° 0·8095. The acid contains 1 equivalent of water, which cannot be eliminated by distillation. Mixed with an excess of water, the acid boils at from 99·8° to 100°, and the condensed vapours form two distinct layers of liquid, one of which is an aqueous solution of the acid, while the upper layer is the hydrated acid. Valerianic acid causes the same deviation of the plane of polarisation as does cane sugar. Butylic valerianate exhibits the same phenomenon, but in a less marked degree.

Researches on the Expansion and Compressibility of Gases.—E. H. Amagat.—Illustrated by woodcuts and tables. The main results of the exhaustive researches herein described are:—(1) Unless gases are well dried, their expansion is (the vessels in which the operations take place being quite dry) not so great as has hitherto been assumed; (2) the differences of the coefficients of the expansion of gases is not, as has been sometimes stated, due simply to moisture; (3) it is impossible to base a hygrometric method on part which the moisture of the air plays in its expansion, because, even when the hygrometric condition of the air differs greatly, the variation of the coefficient is difficultly appreciable.

Polytechniches Journal von Dr. E. M. Dingler, first number for March, 1873.

Application of Titration for the purpose of Estimating the Degree of Alkalinity of Beet-root Juices used in Sugar-Making.—F. Jicinsky.—Nitric acid (sp. gr. 1·2), diluted with 150 times its bulk of pure distilled water, is taken as the standard acid. 1 c.c. of this acid corresponds, by the application to 10 c.c. of juice, to 0·01 per cent of alkalinity in reference to lime. The author describes, and illustrates by woodcuts, the apparatus employed by him for the titration operation. Litmus tincture also is used to indicate the progress of the operation.

Volumetric Estimation of Sugar.—F. Weil.—A previously-weighed or measured quantity of a solution of grape sugar, or of cane sugar first converted into grape sugar, is added to a measured quantity of Fehling's sugar-testing cupreous fluid (to be used in excess, so that after the operation the blue colour yet prevails); the precipitated copper is removed from the solution by decantation, and the quantity of that metal determined by analysis, care being taken to ascertain the total quantity of copper present in the solution. 317 grms. of copper correspond exactly to 180 grms. of grape sugar ($C_{12}H_{12}O_{12}$), or to 171 grms. of cane sugar ($C_{12}H_{11}O_{11}$).

Preparation of Pure Oxalic Acid.—Dr. Habedonck.—The oxalic acid of commerce is treated with the smallest possible quantity of absolute alcohol, which only dissolves the real acid, leaving oxalates of lime, potassa, ammonia on the filter, through which the alcoholic solution passes, The acid crystallises from the alcoholic solution, and is dried at 212° to eliminate any oxalic ether which might have been formed.

Second number for March, 1873.

Contains no original papers relating to chemistry.

First number for April, 1873.

Curious Instance of the Rapid Diffusion of Specifically Lighter Gas Layers through Layers of a Specifically Heavier Gas.—Dr. M. von Pettenkofer.—In the introduction to this essay the author calls attention to the erroneous ideas on the diffusion of gases and on the proper modes of ventilation. As a curious instance of the rapidity, as well as the completeness, of diffusion, the author relates some experiments made by him at Marienbad, Bohemia, on the mineral spring there situated, from which constantly a copious supply of nearly pure carbonic acid is emitted. The gas collected under the surface of the water was found to contain 70 per cent of carbonic acid; at 5 centims. above the surface of the water there was only 31 per cent of that gas; at 25 centims. above the surface the quantity of CO_2 amounted only to 23 per cent: at 100 centims. only 2, and at 145 centims. only ½ per cent of the gas alluded to was found; thus proving that the lighter air (the spring is enclosed in a lightly-constructed wooden shed) actually descends and permeates through the heavier carbonic acid.

Detection of Adulteration in Coffee.—J. Müller.—In order to ascertain whether ground coffee has been mixed with either roasted corn or amylaceous substances generally, it is only necessary to treat the powder, first with dilute caustic potassa, and, after filtration and addition of a large quantity of pure water, a solution of iodine is added, whereby the starch is detected.

Second number for April, 1873.

Change Effected in Cast-Iron Pipes by the Action of a Sulphur-containing Water.—Dr. E. Priwoznik.—It appears that, when the iron mains conveying the mineral water from a source near Hainburg, Austria, were taken up after having been for more than a dozen years underground, the iron thereof had been strongly acted upon, as exhibited by the difference in structure upon the fracture. On being analysed, the author found the interior layer to consist, in 100 parts, of—Hydrated oxide of iron $[(Fe_2)_2O_3(OH)_6]$, 81·08; free sulphur, 12·29; sulphuret of iron, 4·48; hygroscopic water, 0·57; nickel, cobalt, magnesia, silica, traces of carbon, and chlorides of ammonium and sodium, 1·58. The second layer was found to contain only 79·2 per cent of iron, but no sulphuret or excess of carbon was discovered; while the third outermost layer was almost pure cast-iron.

Estimation of Acid in Fatty Oils.—M. Burstyn.—The oils are well mixed with twice their bulk of strong alcohol, 90 per cent at the least; this dissolves the acids which may be present in the oils, while hardly any of the latter are taken up. The alcoholic solution can be readily neutralised with a caustic soda solution of known strength. It is best to take 100 c.c. of the oil to be tested, to which an equal bulk of alcohol is added, care being taken to mix the fluids thoroughly. After some time the alcohol floats on the oil, and 20 c.c. of the former fluid should then be taken for titration. 100 c.c. of good machinery oil should not require more than from 0·4 to 1·4 c.c. of normal caustic soda solution for neutralisation.

Journal de Pharmacie et de Chimie, May, 1873.

Normal Microzymas Present in Milk considered as the Cause of the Spontaneous Coagulation; Alcoholic, Acetic, and Lactic Fermentation of that Fluid; and on the Normal Alcohol and Acetic Acid of Milk.—A. Béchamp.—The main cause of the spontaneous coagulation of milk is, according to the author, the presence therein of minute living organisms, which may be detected in the milk by first diluting it with from five to six times its bulk of creosote water (neither the degree of concentration, nor the mode of preparation of this fluid, are quoted), and next filtering the milk, care being taken to protect the filter from dust. The filter is first washed with ether, for the purpose of eliminating the butter; next, with a dilute solution of carbonate of soda, for the purpose of dissolving some caseine; and lastly with distilled water. On inspection with the microscope (magnifying power 500 diameters) the microzymas will be seen. In order to prove that the coagulation of milk is really due to these

organisms, the author states that he collected milk directly from the udders of a cow, filtered it through fine muslin previously washed with creosote-water, and caused the milk to flow into a vessel containing creosote-water and filled with carbonic acid gas, which was constantly passed through the milk. The vessel and milk quite saturated with that gas was next hermetically sealed, and placed in a drying-stove heated to from 35° to 40°; after two days, the milk was found to be coagulated. The author further ascribes to the microzymas the formation, in sour milk, not only of acetic and lactic acids, and also alcohol, which substances, however, also occur, but, of course, only in extremely small quantity. In fresh milk this is proved by the fact that the latter fluid yields, by distillation, after having been acidified with a slight excess of oxalic acid, alcohol and acetic acid. It should, however, be borne in mind that fresh milk always exhibits an alkaline reaction.

Jordery's Process for Preventing Accidents with Petroleum (Paraffin Oil).—M. Troost.—This paper treats on a proposition made by Jordery to convert petroleum into a butter-like mass by means of the addition of pulverised *Saponaria* root, previously mixed with some water. The result is, that a thick emulsion is formed which is far less inflammable than the oil itself. In order to restore the latter to its usual state, and render it fit for use to burn in lamps, it is only necessary to add to it a small quantity of pure carbolic acid (crystalline) or strong acetic acid. The author states, however, that also (owing to the expense of the *Saponaria* root, a product from the Levant) this process is not as yet practicable on the large scale.

Monatsberichte der Koniglich Preussischen Akademie der Wissenschaften zu Berlin, January, 1873.

Contains no papers relating to chemistry.

NOTES AND QUERIES.

Bursting of Cast-Iron.—A correspondent has forwarded the following extract from the *British Colonist*, a Halifax (Nova Scotia) paper, in the hope that some of our correspondents may be able to throw some light upon the curious phenomenon recorded in it:—"On Tuesday afternoon, while some workmen in Mr. John Hunter's foundry, Sackville Street, were engaged in breaking up a large block of cast-iron by the usual process, the mass burst with a loud report, one of the pieces striking one of the *employes*, a young man named Kennedy, causing serious internal injuries, from which he died yesterday morning. The deceased was one of the "Kennedy" boat crew of four who recently rowed against and defeated four oarsmen from H.M.S. *Royal Alfred*.

Cleaning Silver Articles.—The Boston *Journal of Chemistry* gives the following interesting account of the way in which the natives of East India clean silver articles. The East Indian jewellers never touch silverware with any abrasive substance. For all articles of the kind, even the most delicate, the method of cleaning they adopt is as follows:—Cut some juicy lemons in slices; with these rub any large silver or plated article briskly, and leave it hidden by the slices in a pan for a few hours. For delicate jewellery, the Indians cut a large lime nearly in half, and insert the ornament; they then close up the halves tightly, and put it away for a few hours. The articles are then to be removed, rinsed in two or three waters, and consigned to a saucepan of nearly boiling soapsuds, well stirred about, taken out, again brushed, rinsed, and finally dried on a metal plate over hot water, finishing the process by a little rub of wash-leather (if smooth work). For very old, neglected, or corroded silver, dip the article, with a slow stirring motion, in a rather weak solution of cyanide of potassium; but this process requires care and practice, as it is by dissolving off the dirty silver you obtain the effect. Green tamarind pods (oxalate of potash) are greater detergents of gold and silver articles than lemons, and are much more employed by the artisan for removal of oxides and fire-marks.

"Experiments with the Torsion-Rod for Determining the Mean Density of the Earth," forming vol. xiv. of the *Memoirs of the Royal Astronomical Society*. By Francis Baily, Esq., Vice-President of the Society. London. 1843.

P. 38.—" . . . it is quite clear that both these experimentalists met with certain disturbing forces in the course of their inquiries for the cause of which they could not satisfactorily account, nor for the remedy of which did they make any successful attempt; but against which it has become very requisite that every precaution should be taken in the pursuit of any new experiments."

P. 39 (speaking of anomalies in his earlier experiments).—" . . . . . the arc of vibration during one and the same experiment would seldom decrease in the regular manner which it ought to pursue if the torsion-rod were guided by an uniform influence; and, moreover, that in fact it would frequently *increase* contrary to all the known laws of bodies so circumstanced. I also remarked the same generally *increasing* tendency of the resting-point of the torsion-rod towards the masses when they were brought round to their *near* position." . . . . "But totally different from either of these, and not to be explained on the same principle, was the frequent *spontaneous* motion of the torsion-rod when the masses were remaining in their *neutral* position where they could not exert any influence; I mean those occasional and more extraordinary movements in the arc of vibration which would frequently occur without any apparent cause. In these cases, the *time* of vibration would seldom differ from its mean period, and the *resting-point* would seldom vary from its usual position; but the arc would increase from little or nothing to a very considerable magnitude, and in some instances to such a degree that the balls would strike against the sides of the torsion-box. After continuing for some time in this oscillatory condition, the arc would gradually decrease, and the torsion-rod would ultimately recover its usual state of repose. These phenomena are the more remarkable, since in most of them during the whole period the weather has been generally very calm; and as to temperature, I have seldom been able to discover any material change in the thermometers distributed about the room."

"Notwithstanding these interruptions, I not only considered it proper to continue the experiments for some time in the usual manner, in the hope that I might thereby eventually throw some light on the probable cause of the anomalies, and perhaps be enabled to apply a correction for the effect of their influence; but also was induced to institute several new courses of experiments, as circumstances and suggestions occurred, for the express purpose of elucidating the subject. The theories of electricity, magnetism, temperature, and currents of air . . . . were successively and frequently appealed to, and various experiments made to discover their probable effect on the results. . . . . Red-hot balls and powerful lamps were occasionally applied near the torsion-box with a view to raise an artificial temperature, and thus create a powerful influence; and, on the other hand, masses of ice have been employed for a similar purpose."

"I am principally indebted to Professor Forbes, of Edinburgh, for the most satisfactory removal of the principal anomalies that I had met with. This gentleman's intimate acquaintance with the theory of heat, and its various operations, effects, and influence, led him to agree with Cavendish in opinion that one source at least of the anomalies might arise from the *radiation of heat* from the masses when they were brought up to the sides of the torsion-box; and that this might even still operate, notwithstanding the interposition of the sides of the box and the intermediate boards already alluded to. As a remedy for this influence, he suggested the propriety of having the masses gilt, and also of procuring a *gilt case* as a cover to the torsion-box, for the purpose of preventing the effect of radiation, from whatever source it might arise. Acting upon this advice, I not only caused a gilt case to be made in the manner here proposed, but also caused the torsion-box itself to be previously covered all over with thick flannel. The masses and the plank on which they were placed were not gilt, as such an operation would be attended with some difficulty and inconvenience, but they were covered with gilt paper, and the whole of the interior of the framework was lined in a similar manner; but the 2 inch and 2½ inch leaden balls occasionally attached to the torsion-rod were gilt and burnished. And for the purpose of more effectually preventing the radiant influence of the masses, I altered the position of the stop so as to increase their distance from the torsion-box about 1½ inch more on each side. . . . . The results soon convinced me that the proper mode had been taken for the removal of the principal source of discordance. For, although in some cases slight discrepancies may still appear to exist, as might be expected in any enquiry that involves so delicate a system of operations, yet when the discordances are of greater magnitude, they seem to be confined to one class of experiments, and to depend principally on the nature and construction of the material of which the suspension line or torsion-rod is composed, and do not materially affect the general result of the whole. In fact, I have met with very few experiments made in the regular mode of proceeding that are objectionable, or that need be rejected on account of any anomaly, properly so-called.

"I have already mentioned that the most striking evidence of a disturbing force was the irregularity in the magnitude of the arc of vibration; which has, however, now been removed by the alterations here alluded to. In order to satisfy myself that these alterations were the true cause of the removal, I have several times stripped the torsion-box of its coverings, and commenced experiments in that state; but I have always been obliged to abandon them, in consequence of the irregular influence of the masses on the arc of vibration on whichever side they were brought up."

MEETINGS FOR THE WEEK.

Monday, June 2nd.—Royal Institution, 2. General Monthly Meeting.
Tuesday, 3rd.—Royal Institution, 3. Mr. J. H. Parker, "On Roman Archæology."
—— Anthropological, 8.
—— Zoological, 8.30.
Wednesday, 4th.—Microscopical, 8.
Thursday, 5th.—Royal Institution, 3. Prof. Tyndall, "On Light."
—— Chemical, 8. Sir John Conroy, "On the Dioxides of Calcium and Strontium." J. B. Hannay, "On Iodine Monochloride." T. Wills, "On an Ozone Generator."
Friday, 6th.—Royal Institution, 9.
—— Geologists' Association, 8.
Saturday, 7th.—Royal Institution, 3. Mr. J. Morley, "On the Historic Method."

SUPPLEMENT
TO
THE CHEMICAL NEWS.

VOL. XXVII. No. 705.

ON ZINCO-BARIC CHLORIDE.

By G. J. WARNER, F.C.S.

IT is well known that a concentrated solution of zinc chloride dissolves many other chlorides in large quantity. Double chloride of zinc with potassium, sodium, and ammonium chlorides have been already prepared. Barium chloride is extremely soluble in a solution of zinc chloride, sp. gr. 1·600; and if saturated the double chloride separates on cooling in small deliquescent needles. As the result of several analyses I find their composition to be—$2BaCl,ZnCl_2,4H_2O$; in 100 parts—

	Calculated.	Found.
$ZnCl_2$	32·69	33·05
BaCl	50·00	50·03
H_2O	17·31	By diff. 16·93
	100·00	100·00

The amount of zinc is somewhat too high, owing to the difficulty of separating the crystals completely from the mother-liquor. The sp. gr. of the salt is 2·845.

I have also prepared zinco-magnesic chloride, but have not yet completed the analysis.

Ardwick Bridge Chemical Works, Manchester.

ON THE AMOUNT OF ALCOHOL CONTAINED IN BREAD.

By THOMAS BOLAS.

IT appears to be generally believed that the alcohol which is formed during the process of panary-fermentation is either entirely or almost entirely expelled by the operation of baking, and it may be observed that in most cases writers on panification make no reference to the presence of alcohol in bread. For example, Dr. Miller ("Elements," 2nd ed., iii., p. 142) says—"During this baking, the alcohol formed by the decomposition of the sugar, which corresponds in quantity to that of the carbonic acid, is expelled." Experiment, however, has shown that, by distilling 2 ozs. of ordinary bread with water, and rectifying the distillate, it is easy to obtain a quantity of alcohol which is quite sufficient for recognition.

In order to determine the amount of alcohol quantitatively, about 1 lb. (½ kilo.) of each sample was distilled with water, an addition of about ½ c.c. of oil being made to moderate the frothing, and the distillate was rectified a sufficient number of times, the alcohol being finally determined in the usual way. The results of the examination of six samples of new bread purchased at different shops in London are embodied in the following table:—

	Percentage of Alcohol.
I.	0·245
II.	0·221
III.	0·401
IV.	0·368
V.	0·249
VI.	0·399
Average ..	0·314

These samples were subjected to distillation as soon as practicable after baking, they having been obtained almost immediately after the opening of the shops; and, in order to ascertain the loss of alcohol which bread undergoes on keeping, portions of Nos. III. and VI. were exposed to the air in a moderately warm room for a week, after which time it was found that nearly two-thirds of the alcohol had evaporated, the amount remaining being 0·132 per cent and 0·120 per cent respectively. Although the presence of alcohol in the machine-made (aërated) bread would naturally create surprise, a portion of this kind of bread was, for the sake of comparison, submitted to distillation as in the above cases, and, as might have been expected, no alcohol was detected.

It is probable that the amount of alcohol contained in bread is too small to be of any dietetic importance, but it may be perhaps worth while to notice that forty 2-lb. loaves are about equal in alcoholic strength to an ordinary bottle of port.

I hope shortly to determine the amount of alcohol which dough loses on baking, not only when it is baked in large masses, but also when it is divided into small pieces (rolls) before baking.

CONSTITUTION OF HYDRACIDS IN SOLUTION, AND ON THE INVERSE REACTIONS WHICH THEY CAUSE.

By M. BERTHELOT.

THE author proposes to examine the true constitution of the liquids resulting from the union of hydracids with water, and what is its influence on their chemical reactions. The degrees of heat caused by dilution yield indications. Their progressive increase with the proportion of water corresponds to the existence of certain definite hydrates imperfectly formed in highly concentrated liquids, and whose production is completed by the addition of water. The changes observed in the law of curvature of a line representing the quantities of heat experimentally determined show the formation of a group of definite hydrates, the composition of which is nearly—

$$HCl+8H_2O_2,HBr+4H_2O_2HI+4H_2O_2.$$

The existence of such definite hydrates is confirmed by proofs drawn from the study of the tension of anhydrous hydracids in their solutions. It is sufficient to examine if there exists some limit below which the hydracids cease to be carried away in a notable proportion by a gaseous current. The experimental limit at 12° C. was found to agree closely with the following proportions:—

$$HCl\ |\ 6·5\ H_2O_2;\ HBr+4·2\ H_2O_2;\ HI+4·7\ H_2O_2.$$

These compositions agree with those found by Binean, Roscoe, and Dittmar. Below these proportions, however, the hydracids are still carried off, though in smaller quantity. It is not till 8 to 9 H_2O_2 that the hydrochloric acid volatilised in a gaseous current ceases to act appreciably upon nitrate of silver. The foregoing limits are slightly affected by temperature and pressure. These trifling modifications agree well with the existence of certain definite hydrates—two in number at least—one of which is stable; while the other, less hydrated and less abundant, is in a state of dissociation, partial and varying with the temperature. It is the anhydrous hydracid and not some definite hydrate which is volatilised above the limit of stability. Concentrated solutions contain, therefore, the anhydrous acid; the proportion of which, at a given temperature, may be deduced from the composition of the invariable liquids. Such solutions are in reality a mixture of one or two hydrates in which the anhydrous acid is dissolved. The precipitation of dissolved alkaline chlorides by strong hydrochloric acid may equally serve to check the state of hydration of the latter

liquid. An experiment made with a cold saturated solution of chloride of potassium gave results corresponding closely to $HCl+7{\cdot}5\ H_2O_2$. In other words, strong acid takes away from a saline solution the water necessary to convert itself into a stable hydrate. The salt no longer finding the water necessary for solution, and being, moreover, insoluble in the hydrochloric hydrate, is precipitated in proportion to the water removed. The precipitation experiments concur with those of tension and of calorimetry to show the existence of a certain quantity of anhydrous acid in concentrated solutions, and they afford a new method for ascertaining the real state of hydration of bodies in solution. In fine, the dilute solutions of the hydracids contain only definite and stable hydrates; whilst concentrated solutions contain at the same time hydrates in a state of dissociation and a certain proportion of anhydrous acid. Hence arise contrary chemical phenomena produced by these two classes of solutions; the anhydrous hydracids effecting certain reactions, such as attacking sulphide of antimony, hydrogenising, organic compound, sulphur, and sulphurous acid, &c.; whilst the hydrated hydracids are inactive, or even produce inverse actions. The reversion of their reactions corresponds always to a reversal of their thermic sign; as the stable hydrates of the hydracids develope, at least in their reactions, the heat which has been disengaged at the moment of actual combination between the water and the anhydrous hydracid.

ON THE

EFFECTS OF MAGNETISATION IN CHANGING THE DIMENSIONS OF IRON, STEEL, AND BISMUTH BARS; AND IN INCREASING THE INTERIOR CAPACITY OF HOLLOW IRON CYLINDERS.*

By ALFRED M. MAYER, Ph.D.,
Professor of Physics in the Stevens Institute of Technology.

(Concluded from p. 253).

Although the cognate discovery by our countryman Page, in 1837, that iron bars produce sound on their magnetisation, has been carefully studied by Delezenne, De la Rive, Beatson, Marrian, and Wertheim, yet in the annals of science I have found only two experimental investigations, in addition to the one by Joule, on the phenomena of the elongation produced in iron rods on their magnetisation. The first is by Wertheim, in the *Ann. de Ch. et de Phys.*, 3e Serie, t. xxiii.; the second by Tyndall, contained in a paper entitled "On some Mechanical Effects of Magnetisation," published in his "Researches on Diamagnetism and Magne-Crystallic Action," London, 1870.

In Wertheim's memoir "On the Sounds produced in Magnetised Iron," all we find on the subject of the elongation of magnetised iron rods is the following:—"Here are the results of these experiments: the helix being placed so that its axis coincides with that of the bar, we do not observe any lateral movement, but only a very small elongation; this elongation rarely surpasses 0·002 m.m. [in rods about 970 m.m. long], and although visible is barely measurable; it is most pronounced when the helix [whose length was a little over $\frac{1}{4}$th of that of the rod] encloses the extremity of the bar; it diminishes as the helix approaches the point [the centre] where the rod is clamped, and it is probable that when it is quite close to this point the elongation changes into a retraction, but I have never been able to observe the motion in this direction with any certainty. * * * I have already remarked that it was not possible for me to measure this longitudinal traction; happily Mr. Joule has supplied that omission."

Dr. Tyndall opens his paper thus:—"Wishing, in 1855, to make the comparison of magnetic and diamagnetic phenomena as thorough as possible, I sought to determine whether the act of magnetisation produces any change of dimensions in the case of bismuth, as it is known to do in the case of iron. The action, if any, was sure to be infinitesimal, and I therefore cast about for a means of magnifying it. * * * I consulted Mr. Becker, and, thanks to his great intelligence and refined skill, I became the possessor of the apparatus now to be described. * * * The same apparatus has been employed in the examination of bismuth bars, and, though considerable power has been applied, I have hitherto failed to produce any sensible effect. It was at least conceivable that complimentary effects might be here exhibited, and a new antithesis thus established between magnetism and diamagnetism."

The apparatus used by Dr. Tyndall consisted of two vertical brass rods firmly cemented into a block of stone. Between these rods, securely fixed in the stone, were placed the rods of iron whose elongation he desired to measure. On the vertical rods slid a transverse bar of brass carrying "a vertical rod of brass, which moves freely and accurately in a long brass collar. The lower end of the brass rod rests upon the upper flat surface of the iron bar. To the top of the brass rod is attached a point of steel, and this point passes against a plate of agate, near a pivot which forms the fulcrum of a lever. The distant end of the lever is connected by a very fine wire with an axis on which is fixed a small circular mirror. If the steel point be pushed up against the agate plate the end of the lever is raised; the axis is thereby caused to turn, and the mirror rotates." The angular deflections of the mirror he determined by the method of Poggendorff; that is, by viewing in a telescope the divisions of a fixed scale reflected from the mirror.

Dr. Tyndall gives the following account of his experience with this apparatus:—"Biot found it impossible to work at his experiments on sound during the day in Paris; he was obliged to wait for the stillness of night. I found it almost equally difficult to make accurate experiments, requiring the telescope and scale, with the instrument just described, in London. Take a single experiment in illustration. The mirror was fixed so as to cause the cross hair of the telescope to cut the number 727 on the scale; a cab passed while I was observing,—the mirror quivered, obliterating the distinctness of the figure, and the scale slid apparently through the field of view, and became stationary at 694. I went upstairs for a book; a cab passed, and on my return I found the cross hair at 686. A heavy waggon then passed, and shook the scale down to 420. Several carriages passed subsequently; the figure on the scale was afterward 350. In fact, so sensitive is the instrument, that long before the sound of a cab is heard its approach is heralded by the quivering of the figures on the scale.

"Various alterations which were suggested by the experiments were carried out by Mr. Becker, and the longer I worked with it the more mastery I obtained over it; but I did not work with it sufficiently long to perfect its arrangement. Some of the results, however, may be stated here.

	Figure of Scale.
Bar unmagnetised	577
,, magnetised	470
,, unmagnetised	517

"Here the magnetisation of the bar produced an elongation expressed by 107 divisions of the scale, while the interruption of the circuit produced only a shrinking of 47 divisions. There was a tendency on the part of the bar, or of the mirror, to persist in the condition superinduced by the magnetism. The passing of a cab in that instance caused the scale to move from 517 to 534,—this

* Read before the National Academy of Sciences, in Cambridge, Mass.

is, it made the shrinking 64 instead of 47. Tapping the bar produced the same effect.

"The bar employed here was a wrought-iron square core, 1·2 inch a side and 2 feet long.

"The following tables will sufficiently illustrate the performance of the instrument in its present condition. In each case are given the figures observed before closing, after closing, and after interrupting the circuit. Attached to each table, also, are the lengthening produced by magnetising and the shortening consequent on the interruption of the circuit.

Circuit.	Scale 10 cells.	
Open	647	
Closed	516	131 elongation.
Broken	581	65 return.
Open	637	
Closed	509	128 elongation.
Broken	579	70 return.
Open	632	
Closed	491	141 elongation.
Broken	568	77 return.

Circuit.	Scale 20 cells.	
Open	653	
Closed	475	188 elongation.
Broken	579	114 return.
Open	638	
Closed	452	186 elongation.
Broken	568	116 return.
Open	632	
Closed	472	160 elongation.
Broken	561	89 return.

"These constitute but a small fraction of the numbers of experiments actually made. There are very decided indications that the amount of elongation depends on the molecular condition of the bar.* For example, a bar taken from a mass used in the manufacture of a great gun at the Mersey Iron-works, suffered changes on magnetisation and demagnetisation considerably less than those recorded here. I hope to return to the subject."

That the tilt of the mirror in this instrument should be controlled alone by the molecular motions of the bar was hardly to be expected from a critical examination of the construction of the apparatus. The sudden upward push on the fulcrum might readily cause a minute permanent displacement of this delicate axis, and this change of position being greatly magnified by the lever and mirror would affect considerably the mirror's subsequent position of repose. Also, if on the above sudden and powerful impulse the long arm of the lever received a slight permanent flexure, or if the slender wire connecting the end of this lever-arm with the mirror-axis should become slightly elongated, these strains would determine a change of position in the mirror after contact with the battery was broken. The marked want of stability in the scale-readings I attribute to the fact that the weight of the indicating apparatus was placed on long brass rods, whose upper ends were unrestrained from partaking of tremors whose pulses were synchronous with the time of vibration of its system of weighted rods. These tremors transmitted through the ground to them caused the apparatus to partake of the nature of an instrument known to astronomers as "Hardy's Noddy," which is a species of inverted pendulum, and was even used by Captain Kater to detect any vibrations in the support of the pendulum used in his celebrated "Experiments for Determining the Length of the Pendulum vibrating Seconds" (*Phil. Trans.* 1818, p. 42).

(To be continued.)

* This fact had previously been shown by Joule's experiments.

REPORT ON A MEMOIR OF M. BERTIN RELATIVE TO THE RESISTANCE OPPOSED BY THE HULLS OF SHIPS TO ROLLING MOVEMENTS.*

M. BERTIN gives in his memoir the results of experiments made on the decrease of rolling in calm water resulting from the passive resistance referred to, and the measurement of this resistance. He points out that the maximum amplitude of rolling is not sufficient to characterise ships with regard to the importance of their oscillations. Distinguish between the maximum amplitude, which M. Bertin proposes to call the *mobility*, and the mean and habitual amplitude which he calls the *agitation*, and which, relatively reduced, may be called by contrast the quietness (tranquillity). There are ships of great maximum rolling and of small maximum rolling, agitated and quiet, which must not be confounded with ships unstable and very stable: for very stable ships are in general very much agitated by rolling. To ascertain the laws of quietness in ships, it is necessary to measure both the waves and the rolling; and the instrument M. Bertin uses for this is one somewhat similar to that used by Mr. Froude. It consists of two pendulums, one of which takes 50 seconds and the other half a second in oscillation. Suppose a wave of 5 seconds, the period of the large pendulum will be ten times its duration, that of the smaller a tenth. If they are not too far from the axis of rotation of the rolling they will mark with reference to the ship's vertical longitudinal plane, the first one the absolute rolling, the second the relative rolling of the ship on the normal of the wave; provided always (for the second assertion) the dimensions of the wave are considerable with reference to the volume of hull carried by it. The difference of these two angles will be the inclination of the waves. Tracing-pencils fixed at the extremities of equal radia give two curves which can be easily examined and discussed. The Commission speak of M. Bertin's memoir as being one of considerable interest.

* Abstracted from *Comptes Rendus*.

CORRESPONDENCE.

MILK OF BENGALI COWS.

To the Editor of the Chemical News.

SIR,—Some of your readers may be interested by the following results of some analyses which I have lately made of the milk of our little Bengali cows.

Total solids, as noted in the third column, were estimated by heating 5 grms. of the milk in a platinum dish for four hours in a steam-bath.

Casein was estimated by Mr. Wanklyn's now well-known method.

To estimate the sugar, 20 c.c. of the milk, mixed with 40 c.c. of alcohol, were put aside in a small flask for twenty-four hours. After filtering and washing, the fluid was evaporated to a syrupy consistence upon a water-bath. The residue was then made up with water to 100 c.c., the solution passed through a dry filter, and the sugar in it estimated by means of the copper solution.

Fat was estimated by two methods. One, the old method of evaporating to dryness 20 c.c. of the milk, mixed with sulphate of lime, and subsequent exhaustion with ether. The other method was as follows:—10 c.c. of the milk, with 10 c.c. of alcohol and 10 c.c. of ether, were introduced into a glass tube of about 50 c.c. capacity. The tube was then sealed, and exposed in a water-bath to a

temperature of 180° F. for about two hours. When the tube had cooled, its end was broken off, the fluid contents drained into a small flask, and the solid matter remaining in the tube exhausted of fat by two or three boilings with ether. The contents of the flask were evaporated to about 10 c.c., then ether added to dissolve the fat, the ethereal solution separated, and evaporated to dryness in a very small weighed glass beaker. Before calculating the weight of the fat, the solubility in ether of the residue in the beaker was ascertained.

Anyone wishing to try this method of estimating the fat of milk, but who is unprovided with the means of sealing up the fluid in a glass tube, will find one of the long old-fashioned eau-de-Cologne bottles answer the purpose. The bottle must be provided with a very good cork, which must be tied down. The water-bath may be a tall cylindrical tin vessel. The bottle should be immersed to within an inch of its mouth in the water.

The following is the ordinary food of a Bengali cow, but the animal in the Bengali's hut plays very much the part of the Irishman's pig, and, with its master, has occasionally to manage as it best can:—About 12 lbs. of rice straw, 2½ lbs. of oil-cake, 1 lb. of husks of rice, sometimes a little very poor grazing, the water in which the family rice has been boiled, and about 35 lbs. of water.

	Age of Calf.	Weight of Milk given by the Cow each Day.	Solids of Milk.	Casein.	Sugar.	Fat.	Salts.
	Months.	Lbs.	Per cent.				
1.	1	6½	15·12	5·50	3·98	4·98	0·76
2.	2	5	12·82	4·30	4·40	3·60	0·70
3.	2½	5	15·28	5·76	4·10	4·10	0·84
4.	5	4	11·90	4·30	4·37	2·52	0·78
5.	6	10	12·04	4·30	4·10	3·20	0·70
6.	7	5	11·65	5·40	3·86	1·90	0·82
7.	10	4	11·92	4·20	4·37	3·00	0·68
8.	This cow is two months in calf, and is milked only about once in two or three days.		15·90	7·76	3·40	4·10	0·90

—I am, &c.,

F. N. MACNAMARA.

Calcutta, April 10, 1872.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in apparatus employed in the manufacture of salt. Otto Ernest Pohl, salt manufacturer and merchant, Liverpool, Lancaster. October 22, 1872.—No. 3116. The object of my invention is to produce salt in a merchantable condition at less cost. For that purpose I proceed as follows:—First. As means for economising fuel I arrange ordinary or convenient evaporating pans, one on the top of or over the other, and pass the flames, heating gases, or products of combustion over the brine at the lower pan, and at the same time under the bottom of the top pan. Doors are provided for withdrawing the salt from the bottom pan. Series of double pans may be used, and the flames, heating gases, or products of combustion and steam led over the brine. Second. As means for providing a cheap and durable cover for evaporating pans I construct such covers of a combination of wood or other suitable material and lead, lead being used to line the wood or other material forming the frame.

Improvements in furnaces for burning sulphurous ores. Alfred Vincent Newton, mechanical draughtsman, 66, Chancery Lane, Middlesex. (A communication from Konrad Walter, Augsburg, Bavaria). October 23, 1872.—No. 3142. The grate of the furnace on which the iron or copper pyrites (reduced to a suitable size) is laid is formed of bars which are capable of rocking in their bearings. These bars are made of such a section that when in their normal position the spaces between them will be sufficiently narrow to ensure the retention of the ore in the grate, but when rocked will open spaces for the discharge of the ore that lies next the bars.

Improvements in protecting walls and other erections of brick, stone, iron, and wood from moisture. Robert Knott, chemist, Bolton, Lancaster. October 24, 1872.—No. 3154. This invention consists in the use of glue or similar substances and a salt, as bichromate of potash, to render it insoluble.

Improvements in obtaining caustic baryta. Thomas Cobley, Dunstable, Bedford, and John Edgar Poynter, Glasgow, Lanark. October 28, 1872.—No. 3194. In carrying out the invention barium sulphide is mixed with heavy oil or creosotic liquor and submitted to distillation. A combustible gas is obtained, and after being freed from sulphur compounds may be used as an illuminating gas, or as a fuel. The caustic baryta may be washed out of the residue, or it may be applied in many cases in its crude coke-like form.

Improvements in the manufacture of white-lead and apparatus therefor. William Thompson, 101, Wandsworth Road, Surrey. October 29, 1872.—No. 3202. This invention relates to improvements in the process of and apparatus used in manufacturing white-lead. The melting pan is made in compartments for regulating the temperature and securing the purity of the blue lead. This lead is made into thin sheets of open texture by pouring it into a revolving cylinder kept cool, and it is granulated by running it in a thin stream between a roller and an inclined knife, and receiving it in water. The sheets and granules are charged on trucks which are run upon rails into the chambers where the chemical reagents act on the lead so as to convert it into white-lead; the trucks charged with the converted lead being run out at opposite doors.

Improvements in bleaching textile fabrics and other fibrous materials. Baldwin Fulford Weatherdon, C.E., 77, Chancery Lane, Middlesex. (A communication from John Palliser, Robert McDowell, Adolphe Klopsk, and Victor Grumel). October 31, 1872.—No. 3231. This invention consists in bleaching textile fabrics and other materials, without any previous preparation, by immersing them in a bath composed of chlorine, soda-salt, and sub-carbonate of soda neutralised by exposure to the oxygen of the air for a certain time.

Improvements in gas lamp blowpipe apparatus, part of such improvements being applicable to other spirit lamps. John Robert Harper, Clerkenwell, Middlesex. November 1, 1872.—No. 3233. The first part of these improvements consists in so constructing and regulating the aperture or apertures of the jet pipe or burner as to admit of benzoline, paraffine, naphtha, or other analogous oils or spirits being employed for generating gas under pressure in the oil or spirit vessels of gas lamp blowpipe apparatus. Another part of these improvements consists in applying two or more jet pipes to such apparatus, and also in attaching the jet pipes to the oil or spirit vessel of gas blowpipe apparatus by means of a gas union joint or otherwise. Another part of this invention relates to the application of an improved arrangement or construction of safety valve to the oil or spirit vessels of gas blowpipe apparatus. Another part of this invention relates to an improved construction of the wick tubes or holders of spirit lamps of all kinds, for the purpose of preventing the transmission of heat from the flame to the oil or spirit in the reservoir. Another part of these improvements consists in securing the spirit lamp in the case or frame below the oil or spirit vessel by means of a self-acting locking contrivance, which holds the lamp firmly in position. Another part of these improvements consists in so arranging the vessel in which the gas is generated, and the lamp through which the jet is directed, that the flame may impinge and act upon a horizontal surface either above or below the apparatus. Another part of these improvements in gas lamp blowpipe apparatus consists in arranging and mounting a series of such separate lamp apparatus in a case or frame for directing a number of gas jets upon an extensive surface required to be thus acted upon.

Improvements in metallic alloys applicable where copper, tin, zinc, brass, Muntz's metal, and other like metals and alloys are now used, Paul Auguste Desjardin, M.D., Paris. November 1, 1872.—No. 3244. The metals used in the formation of this improved alloy, or alloys, are copper, tin, zinc, arsenic, and nickel, in various proportions, according to the use and colour required. In some cases one or more of the ingredients are omitted.

Improvements in mixing, charging, and smelting iron ores. Edward Withy and William Gibson, West Hartlepool, Durham. November 2, 1872.—No. 3252. The object of this invention is to save fuel as much as possible. In effecting this, in the first place, the ores are crushed and ground, and the smaller they are ground the less fuel they take to smelt them. Second. The pulverised ores are mixed with the required quantity of lime and water to a stiff paste, which paste is forced into moulds or through dies, in a similar manner to drain tiles, the dies being made to give such shape or form to charging sections as will afford the greatest amount of heating surface, according to the weight and strength of the materials. With these sections are charged blast-furnaces, puddling-furnaces, cupolas, and vibratory-furnaces, in manner described in Letters Patent No. 2672, A.D. 1872, and more especially they are used in the improved puddling-furnaces described in said Letters Patent.

Improvements in fixing salt pans and in arranging the furnaces under the same. Joseph Parks, Wincham Boiler Works, Northwich, Cheshire. November 2, 1872.—No. 3260. According to this Provisional Specification the pan is supported on pillars, so that the whole or nearly the whole of the bottom becomes available as heating surface.

Improvements in the production of oxygen gas. James Alfred Wanklyn, 11, Harrington Street, Hampstead Road, Middlesex. November 2, 1872.—No. 3261. The feature of novelty of this invention consists in utilising the chemical properties of copper and oxide of copper in the preparation of oxygen gas.

THE CHEMICAL NEWS.

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ON ANILINE BLACK.

By CH. LAUTH.

IN May, 1869, I made public a process for dyeing aniline blacks by means of peroxide of manganese employed as mordant and oxidising agent. The practical application of this process, although it yielded results very satisfactory as regards the beauty and solidity of the blacks, was beset with difficulties, which caused it to be abandoned. But, as in this investigation I came upon several novel facts, it may be interesting for chemists desirous of carrying on further researches in the same field to know the exact conditions of my process and its attendant drawbacks.

Dyers are generally of opinion that, to dye yarns uniformly and regularly, drying must be avoided. The fixation and development of colours by means of dryings always gives rise to difficulties which are not encountered when we pass the yarn, without drying, from one bath to another. In dyeing thick bundles of cotton yarn, the interior of the hanks is much less exposed to the air than the exterior, and consequently, if the development of the colour is due to the action of the air, it is very probable that, in spite of the skill of the operator, inequalities of shade will occur. On the contrary, when the yarns are plunged successively into baths where they are uniformly moistened, and where they are in contact with the mordant and the colouring matter, there is much less probability of inequalities. In the case of aniline blacks, the inconveniences of a dry procedure have been already pointed out, and I do not see how they can ever be completely avoided.

On the other hand, aniline black, being necessarily absolutely insoluble, cannot be fixed like another colouring matter, but must be formed in the place which it is to occupy upon the fibre. To mix, with a salt of aniline, oxidising agents capable of producing the black, and to wash the yarn in such a bath until the colour is developed, is a method which does not yield good results, because the black, instead of fixing itself upon the fibre, remains suspended in the liquid. Mordanting the fibre with an oxidising agent which is soluble, or capable of being rendered so in the dye-bath, equally occasions the development of colour in the liquid, and consequently involves considerable losses.

It seemed to me that one method only for dyeing aniline blacks was practicable; fixing a salt of aniline upon the fibre in an insoluble state, and then passing it into an oxidising bath, or, inversely, fixing on the fibre an insoluble oxidising agent, and passing it subsequently into the solution of a salt of aniline. The second modification alone gives useful results; and, practically, it may be reduced to the fixation upon the fibre of oxidising agents rich in chlorine or oxygen, capable of easy decomposition, but incapable of diffusing themselves in the dye-bath and of wasting the colouring compounds with which the bath is charged. The agents in question are the higher oxides of manganese, binoxide and chlorite of lead, &c. Binoxide of manganese has especially attracted my attention.

Fixation of the Mordant.—The simplest process for fixing manganese upon cotton, wool, or silk consists in plunging these fibres into the solution of an alkaline manganate or permanganate. These salts are, unfortunately, very expensive. I had recourse, therefore, to the old process for manganese bronze, which consists in soaking the fibres in a salt of manganese (acetate, sulphate, or chloride), then passing them into caustic soda, and oxidising the protoxide of manganese thus fixed by means of chloride of lime. To get an intense black, it is necessary to mordant in chloride of manganese at 40° B., working the cotton in this bath for an hour, wring out well, then, without rinsing, pass it into boiling soda lye at 12° B., holding lime in suspension. Or the cotton may be first mordanted in a boiling manganese bath, and then passed through cold alkali. After the fixation of the oxide, the cotton is washed in much water, and passed into a lukewarm chloride of lime bath, regulating the proportion of this agent so that it may never be found in great excess, which might injure the fibre. It is best to add the chloride of lime little by little till the manganese bronze is sufficiently intense.

At first sight this method seems very practical, and, nevertheless, the difficulties met with have caused the process to be abandoned. The treatment with soda is offensive to the workmen, and roughens the cotton. The oxidation is a delicate process, as it is important not to injure the fibre. In short, if each step is simple, the whole requires precautions which yarn dyers are not accustomed to take. The process, it should be added, has given good results when applied in calico-printing.

I have endeavoured to modify the conditions of fixing the manganese. I mention a single remarkable result. A tissue, mordanted with manganese and placed in a chamber filled with ammoniacal gas, is found of a deep brown when taken out, the protoxide of manganese becoming readily peroxidised under these circumstances.

Dyeing.—The yarns, charged with manganese and well washed to eliminate all uncombined matter, are steeped in a cold acid solution of aniline. The colour is formed almost instantaneously. As soon as the bronze comes in contact with the aniline salt, the reaction takes place. The binoxide of manganese oxidises the aniline, and the black formed takes the place of the metallic compound. The operation is finished in one or two minutes, but the yarn may be left an hour in the bath without inconvenience. The proportions to be employed vary according to the intensity of the black desired. An excess of acid must be always used; thus, to 10 or 20 grms. of aniline per litre 60 grms. of sulphuric acid must be added, or to 50 grms. of aniline 150 of acid. If these limits are much exceeded the mordant may be attacked. The sulphuric acid may be replaced by other mineral acids, such as the hydrochloric, arsenic, &c. When taken out of the dye-bath, the cotton is well washed and passed into a boiling alkaline bath—soap or soda—to remove the last traces of acid and give the black its full beauty.

Brightening.—After dyeing, the shades may be modified and their intensity augmented by means of different agents. This indicates that, when the binoxide of manganese has completed its action, the colouring matter is still in a transition state, in which further oxidation may be useful.

Bichromate of potash, at 1 grm. per litre, salts of copper, mercury, and chrome, and especially a mixture of chlorate of potash, a salt of copper, and sal-ammoniac (1 grm. of each per litre), increases the intensity of the black. This treatment is applied after the washing subsequent to dyeing, and is carried on for half an hour at a boiling heat. It is followed by a second washing and by boiling in soap-lyes. The process described gives fine, solid blacks; it is speedy, and does not injure the fibre.

On the other hand, we must not forget the difficulties of the mordanting process, and the black stains off a little when rubbed.

In calico printing, my process is suitable for:—Black grounds. Black grounds, with discharge effects in all colours. Greys, produced by weaker mordants. Black patterns, along with greys and other shades capable of resisting the operations above mentioned (iron, chrome, copper, indigo, catechu, &c.). Joint application of black and indigo. Blue grounds, with white discharge and black patterns.

The nature of the coal-tar base employed is very important. Pure aniline, used alone, gives a very fine

intense black. Toluidine, a blue-grey. Methyl-aniline, a violet-black. Naphthylamine, a violet-brown.

The differences of shade are so striking that cotton cloth mordanted in this manner may be used to determine the comparative value of commercial anilines.

ON PROPYLAMINE AND TRIMETHYLAMINE, AND THEIR THERAPEUTICAL USE.

THE particulars in the following account are from a recent article by Prof. Gubler, of Paris :—

It is nearly twenty years since these two artificial alkaloids were introduced into the "Materia Medica" by an eminent St. Petersburg physician, and yet their existence seems to have been pretty much ignored by the majority of practitioners till quite recently.

The experiments of Awenarius, commenced in 1854 and published ten years later, attracted attention from only a few observers; among these an eminent Belgian, M. V. Guibert.

Some years later, the Russian doctor Kaleniezenko took up the work commenced by his fellow-countryman Awenarius, and published an interesting monograph on *propylamic medicines*. While Awenarius had applied propylamine in treatment of acute febrile disease, and specially rheumatism, Kaleniezenko regarded chiefly the alterative action which he considered it to have in chronic disease, especially the manifestations of scrofulous and tuberculous diathesis. He considered that cod-liver oil owed its efficacy to the volatile alkaloids contained in it, and other substances, also containing them among their principal constituents, would act in the same way. The idea is ingenious, but it is neither proved nor probable.

In June, 1872, an original memoir on the subject appeared in Italy, and, about the same time, one in America. Both publications excited the curiosity of medical men in France and England, and the therapeutical study of propylamine is now engaging considerable attention on both sides of the channel.

Propylamine is an excessively volatile liquid with a strong penetrating odour, like that of ammonia, and which, when diffused in the air, often resembles that from the brine of herring or of sardines. It is soluble in water, which it makes strongly alkaline, combines energetically with acids, and forms salts generally soluble in water and in alcohol, and capable of exhaling an odour of fish when either heated or treated with a fixed alkali. This alkaloid is found in the flower of hawthorn, in the fruit of sorb, in several *Chenopodia*, in spurred rye, in human blood and urine, and in cod-liver oil.

Propylamine and *trimethylamine* are isomers; their formula is C_6H_9N, but they differ somewhat in structure. The first may be represented by ammonia, NH_3, in which 1 molecule of hydrogen is replaced by 1 molecule of propylene, C_6H_7; while, in the second, 3 molecules of methyl, C_2H_3, are substituted for 3 molecules of hydrogen. These differences in grouping are necessarily connected with differences in physical, chemical, and physiological properties.

The two forms of C_6H_9N are commonly found together, and, owing to their extreme volatility and facility of metamorphosis, their extraction and isolation is very difficult. They have not yet been obtained, except in the state of mixture, and probably associated with other ammonia compounds. Moreover, they have only been obtainable in aqueous solution, more or less concentrated; whether by reason of the process of extraction, or the impossibility of preserving in the free state liquids so volatilisable—one of them (propylamine) boiling at $+45°$, and the other at $+5°$. They are therefore not administered in the pure state in medicine, and this may account for some of the discrepancy of statement as to their action.

Further, the very existence of propylamine in the complex substance used in medicine has been called in question by some eminent authorities. Thus, Hofmann has sought in vain for it in the brine of herring; he has only succeeded in finding its isomer, trimethylamine. Silva, indeed, has obtained propylamine, but only in very minute quantity.

The uncertainty increases when one reflects that, according to the richness of the brine submitted to distillation, in presence of caustic potash, to expel the volatile alkalies, and according to the manner of the operation, we may obtain solutions more or less charged with active principles.

M. Petit's researches have brought to light some curious facts. He subjected to alkalimetric tests several different products sold under the name of propylamine, and with the following results :—

Using a sulphuric liquor, 1 c.c. of which exactly saturated 0·06 gr. of propylamine, he found 0·2 c.c. of the acid solution was necessary to neutralise 1 gr. of propylamine F; 0·3 c.c. for the same quantity of propylamine P; 0·6 c.c. for the product D; 1·2 c.c. for A; and 2·5 c.c. for that designated S.

Thus, the propylamine S, which contained 0·15 c.c. alkaloid per gramme, was more than ten times richer than the propylamine F, which contains only 0·012 c.c. There must be considerable disparity of action in medicines so unlike.

To all these causes of error should probably be added another, which may not be the last. Propylamine and trimethylamine, in presence of light or in contact with the atmosphere, is transformed gradually, and often quickly, into ammonia properly so-called, NH_3, and into one or several other products representing C_6H_6. In fact, propylamic solutions, immediately after being obtained, give a peculiar sweetish and slightly aromatic odour, approaching that of ammonia, but quite different; whereas, the emptied vessels, several days after, exhale the strong pungent odour of the volatile alkali, and appear, at least, to contain only pure ammonia.

Allowing for these sources of difference in observation, the following is what seems most clearly established as to the physiological action and therapeutical effects of propylamine and trimethylamine, or, rather, of propylamic solutions :—

Propylamine somewhat reddens the surface of the skin, causes a sensation of heat and burning in the first passages, and retards the pulse. Additional experiments are necessary to explain this retardation. The recent observations of Namiais do not solve the problem. He has observed, however, not only a diminution in the number of heart-beats, but a lowering of temperature and increase of the aqueous diuresis; so that he considers the action of propylamine similar to that of digitalis, but undoubtedly superior. He further observed that the pulse, retarded by propylamine, lost, at the same time, in force and fulness, indicating diminution of vascular tension, and, also, it would seem that the circulatory retardation is not produced by the same mechanism in the two cases.

Awenarius was the first to apply propylamine in therapeutics. Dr. Gaston, of Indiana, following his example, applied the alkaloid in treatment of acute articular rheumatism. Namiais, of Venice, guided, on the other hand, by his own researches, used it as a substitute for digitalis and its active principle, in cases where it was necessary to moderate the circulation and to increase the flow of urine, *i.e.*, in organic affections of the heart, and dropsies dependent on them. More rarely, he has employed propylamine to stimulate perspiration.

There followed the researches of Dujardin Beaumetz, Besnier, and several other French physicians.

Dujardin Beaumetz does not regard propylamine as a mere sedative of inflammation or of fever, after the manner of quinine, but as an agent for extinguishing rheumatism locally, and repressing its fresh appearance.

"Unfortunately, a most attentive and prolonged study of the effects does not allow me to share the convictions of our distinguished colleague. My own experience,

somewhat limited as yet, but fortified by that of Pidoux, and other practitioners in the City hospitals, reduces the use of propylamine to that of a palliative for articular inflammation and rheumatic fever, which does not prevent relapses, and has not the extraordinary power which we might have desired."

For applying to the skin, Guibert recommmends the use of pure propylamine. For mucous surfaces, it should be more or less diluted; for internal use, Awenarius prescribed it in potions of 1 to 4 grms. and more, in 125 grms. of distilled water aromatised with peppermint. This maximum has never been reached by the others. "For my own part, I have prescribed doses varying from 1 to 3 gr., and with the latter dose, I have only obtained obscure physiological results, and so slight and inconstant a retardation of the blood circulation that I could not affirm that it had the effects of medicinal action. In one case, on the contrary, I observed a general stimulating action, characterised by peripheric heat, pricklings in the skin, a tendency to perspiration, and restlessness in the limbs. But I am unwilling to draw any formal conclusion from this single fact; though it seems quite natural to expect stimulating effects from substances so closely allied to ammonia, and capable of progressive metamorphosis into a volatile alkali.

"My provisionary conclusion is this—The concordant facts observed in Russia, Italy, the United States, and France, by eminent clinicians, warrant the belief that propylamic solutions exert a favourable influence on rheumatism and phenomena of circulatory excitation; still, the demonstration of this therapeutical action is not yet furnished, and truly scientific experimentation will only commence when we shall be in possession of one or of several agents well defined and always identical."

INVESTIGATIONS ON PARA-SULPHOBENZOIC ACID.

By IRA REMSEN.

(Continued from p. 215).

III. *Formation of Parasulphobenzoic Acid from Sulphotoluenic Acid.*

WHEN substituting agents are allowed to act upon toluene, in the case of derivatives containing one substituting group, two products are formed. These are the para- and ortho- varieties. The former is always produced in much larger quantity than the latter. This has been proved by Engelhardt and Latschinoff,* and by Wolkow,† in the case of the sulpho-derivatives. Wolkow proved that the products belonged to the para- and ortho-series, by converting them respectively into paraoxybenzoic and salicylic acids. According to the experiments of the chemists mentioned, the two sulpho-acids can be separated by partial crystallisation of the potassium salts. In this way the para-salt was obtained in a perfectly pure condition, while the ortho-salt could not be freed entirely from the para-salt.

Now, as it had been shown that the oxidation of the mono-brom- and mono-chlor-derivatives of toluene yielded corresponding derivatives of benzoic acid, the idea naturally suggested itself that similar treatment of sulphotoluenic acid might yield the desired derivative of benzoic acid. My best hopes were satisfied. After a few experiments it became evident that by means of this reaction I could prepare parasulphobenzoic acid in unlimited quantity with but comparatively little labour.

The principal difficulty that presented itself was to be looked for in connection with the fact that the sulpho-acid is exceedingly easily soluble; and some method had to be devised to extract it from the oxidising mixture, provided it were formed. A preliminary experiment, made with a small quantity of the potassium salts of the sulphotoluenic acids, showed that they were easily acted upon by a mixture of sulphuric acid and potassium bichromate. Taking advantage of the suggestion of Fittig,* with the hope that the ortho-acid would be destroyed by the oxidising agents, I subjected the mixture of the two potassium salts to the influence of sulphuric acid and potassium bichromate in noted proportions. The oxidation, when once commenced by gently heating over a water-bath, proceeds rapidly to the end without the further aid of heat, and is completed in the course of a few minutes. The liquid becomes very hot, and foams somewhat; an evolution of gas takes place as long as the oxidation-process continues; and its cessation indicates the end of the operation. In order to extract the product from the mixture the whole was diluted with a large amount of water, and chalk added to the point of neutralisation. By this means the chromium oxide formed and the excess of sulphuric acid were precipitated, and in the solution remained the potassium salts of the sulpho-acid or acids, together with some neutral potassium chromate. Baryta-water was now added in sufficient quantity to precipitate exactly the chromic acid present, this filtered off, and the filtrate evaporated almost to dryness. The colourless residue consisted of the potassium salts, together with some potassium hydroxide. The mass was first neutralised with sulphuric acid, and then a sufficient quantity of the latter added to set the sulpho-acids free, care being taken to avoid any large excess. Moderately strong alcohol being now poured upon the mixture, an abundant deposit of potassium sulphate took place. This was filtered off, the salt well washed out with alcohol, and the alcoholic filtrate evaporated down again to a small volume. Potassium sulphate was again deposited. This was filtered off, washed out, &c., and the operation repeated a few times. Finally, the alcoholic solution was boiled for some time with water, and then evaporated to dryness over the water-bath. In this way the sulpho-acids were obtained in a free state without impurities. The acid barium salts were prepared, and, on bringing their solution to the point of crystallisation, large acicular crystals were at once deposited, and these possessed the characteristics of the acid barium salt of parasulphobenzoic acid already described. They were analysed with the following results:—

0·5415 grm. salt was heated above 200°, and lost 0·0495 grm. H_2O; and gave 0·2130 grm. $BaSO_4$ = = 0·12524 Ba.

	Calculated.		Found.
$(C_{14}H_{10}S_2O_{10})$	402	67·79	
Ba	137	23·10	23·13
$3H_2O$	54	9·11	9·14
	593	100·00	

This shows, then, conclusively that by the oxidation with sulphuric acid and potassium bichromate, the sulpho-group of parasulphotoluenic acid remains intact. The conduct of the ortho-acid under like circumstances I shall refer to below. As far as I have been able to discover, by a consultation of the literature, this is the first attempt which has been made to oxidise sulpho-acids in the manner described. The simplicity of the reaction and the satisfactory character of the results lead me to desire the further application of the principle involved, and I shall take the first opportunity to prepare a pure sulphoxylenic and sulpho-mesitylenic acid, with the object of subjecting them to the influence of oxidising agents, hoping thus to obtain an *oxybibasic* and an *oxytribasic* acid.

After having gained the necessary preliminary knowledge, I proceeded to determine the best conditions for the reaction. A large number of experiments were made, and as the result I would give the following directions:—Instead of first preparing the potassium salts of the sulphotoluenic acids, I employed a solution of the acids in sulphuric acid, considerable labour being thus saved. 25 grms. of pure toluene are dissolved in 200 grms. of

* *Zeitschrift für Chemie*, N. F., 5, 615. † *Ibid.*, N. F. 6, 321.

* *Ibid.*, N. F. 7, 179.

fuming sulphuric acid without the aid of heat. When this solution has cooled down somewhat, two volumes of water are added, and the height of the liquid in the flask marked. Now more water is added, and the mass subjected to distillation until the liquid has reached the original volume indicated by the mark on the vessel. In this way any toluene which may have remained unacted upon by the sulphuric acid is removed. The solution is now allowed to cool to the ordinary temperature, and then 160 grms. of coarsely-powdered potassium bichromate gradually added. In order to start the oxidation the flask is placed on a water-bath, and gently heated for about ten minutes. During this time a commotion is noticed in the liquid, which gradually increases. An active foaming ensues, and when this has fairly begun the flask is removed from the water-bath. A uniform evolution of gas continues until the end of the operation, which occupies usually about twenty minutes in all. The gas evolved is carbonic acid, as was proved by appropriate reactions. In heating the mixture at first, it is absolutely necessary to place it on a water-bath; if the attempt be made to heat with a flame the flask invariably breaks. This is occasioned by the fact that the potassium bichromate lies at the bottom of the flask, and that the oxidation commences and goes on rapidly just at the spot where the heat from the flame is strongest. This spot immediately becomes very hot before the remainder of the glass has been at all heated, and from this spot a circular piece of glass inevitably drops, followed by the contents of the flask. When the operation is at an end, which, as stated, is indicated by the cessation of the evolution of gas, the whole is diluted with water, and then treated successively, as above described, with chalk, baryta-water, sulphuric acid, and alcohol. By this method, in the course of a few days, a very large quantity of pure acid barium parasulphobenzoate can be prepared.

Parasulphobenzoic Acid, $C_6H_4\begin{cases}SO_2.OH\\CO.OH\end{cases}$, is prepared from the barium salt by precipitating the barium exactly with pure sulphuric acid, and evaporating the solution. It is very easily soluble in water, and crystallises from a very concentrated solution in the form of beautiful, colourless, transparent needles. These, though very easily soluble, are not deliquescent. They fuse above 200°, but undergo decomposition before the fusing-point is reached. The meta-acid is deliquescent.

Potassium Parasulphobenzoate, prepared by neutralising and precipitating the acid barium salt by means of a solution of pure potassium carbonate, is exceedingly easily soluble in water, but crystallises finally in well-formed transparent needles.

Acid Sodium Parasulphobenzoate,—

$$C_6H_4\begin{cases}SO_2.ONa\\CO.OH\end{cases}+2\tfrac{1}{2}H_2O.$$

—This salt was prepared by neutralising and precipitating the acid barium salt with sodium carbonate, and then adding hydrochloric acid to the solution, evaporating, and allowing to crystallise. It forms beautiful, long, colourless, lustrous, stellate prisms. It is moderately easily soluble in cold water, more easily in hot water. The corresponding salt of the meta-acid is more difficultly soluble in cold water, and crystallises in laminæ. The two, when present in the same solution, cannot, however, be separated. The analysis of the salt gave the following results:—

0·3707 grm. of the salt, dried over sulphuric acid, on being heated gradually to 310°, lost 0·0607 grm. in weight; and then gave 0·102 grm. Na_2SO_4 = 0·033038 grm. Na.

	Calculated.		Found.
$(C_7H_5SO_5)$	201	74·72	
Na	23	8·55	8·91
$2\frac{1}{2}H_2O$	45	16·73	16·37
	269	100·00	

The remarkable fact will be noticed that the water of crystallisation is not driven off entirely until a high temperature (320°) is reached. All other salts of this acid, as well as of the meta-acid, which contain water of crystallisation, exhibit the same property, though not in such a marked degree as this one.

Barium Parasulphobenzoate, $C_7H_4SO_5.Ba+2H_2O$. — This salt was obtained by neutralising a solution of the acid salt with barium carbonate. It is moderately easily soluble in cold water, very easily in hot water. It crystallises in small needles, which are grouped together in verrucose masses. The corresponding salt of the meta-acid is also easily soluble in water, but according to the descriptions given it contains no water of crystallisation. The analysis resulted as follows:—

0·4174 grm. salt, dried over sulphuric acid, on being heated gradually to 190°, lost 0·0411 grm. H_2O; and then gave 0·2587 grm. $BaSO_4$ = 0·15212 grm. Ba.

	Calculated.		Found.
$C_7H_4SO_5$	200	53·62	
Ba	137	36·73	36·44
$2H_2O$	36	9·65	9·84
	373	100·00	

Acid Barium Parasulphobenzoate,—

$$(C_7H_5S_2O_5)_2Ba+3H_2O.$$

—The methods of preparation and analysis of this salt have already been given in detail. It is by far the most characteristic salt of parasulphobenzoic acid, and its properties are such as to render its preparation in an absolutely pure condition very simple. It is exceedingly difficultly soluble in cold water. When perfectly pure the length of the crystals is only dependent upon the depth of the liquid in which they are formed. It is more difficultly soluble, both in cold and in hot water, than the meta-salt. Like the meta-salt it does not give off its water of crystallisation entirely below 200°, and it may be subjected to a much higher temperature without the danger of decomposition.

Calcium Parasulphobenzoate is an amorphous powder which is somewhat more easily soluble in cold water than in hot, and is hence thrown down when a concentrated cold solution is boiled.

When the potassium salts, obtained in the preparation of acid barium parasulphobenzoate by evaporating the solution which has been treated with chalk and baryta-water, are fused with potassium hydroxide, a mixture of paraoxybenzoic and salicylic acids is obtained, the salicylic acid forming in some cases fully half of the product. This fact taken alone led at first to the conclusion that the methyl groups of both the para- and ortho-sulpho acids had been oxidised; and that thus not only parasulphobenzoic acid had been formed, but at the same time orthosulphobenzoic acid. Further investigation, however, showed conclusively that this was not the case, but proved another interesting fact, of which I shall speak below.

IV. *Formation of Terephthalic Acid from Parasulphobenzoic Acid.*

The recent experiments of V. Meyer* have tended to materially modify the prevalent views in regard to the constitution of the bi-derivatives of benzene. Meyer showed that ordinary sulphobenzoic acid, which, on the one hand, could be converted into oxybenzoic acid, could, on the other hand, be converted into isophthalic acid by fusing its potassium salt with sodium formate. As, according to the reigning ideas, isophthalic acid can only have the constitution indicated by the 1·3 position of its carboxyl groups, it became evident that oxybenzoic acid, which up to that time had been looked upon as belonging to the same series as phthalic acid, viz., the ortho (1·2) series, in reality belonged to the meta (1·3) series, of which

* *Berliner Berichte*, iii. jahrgang, 112; and *Ann. d. Chem. u. Pharm.*, clvi., 265.

isophthalic acid is the most satisfactory representative. Salicylic acid thus became the 1·2 oxybenzoic acid, and the formulæ of a number of compounds were subsequently changed of necessity to place them in concordance with the results of the above reaction. But to take thus one experiment as the basis of a change as serious as that which ensued was looked upon by some chemists as insufficient; and indeed Meyer himself, in his first notice* on this subject, says—"Bei allen Schlüssen, die wir aus Reactionen, wie die oben beschriebene, ziehen, mahnt freilich die von Kekulé beobachtete Thatsache, dass die Phenolsulfasäure mit Leichtigkeit aus der Meta-Stellung in die Para-Stellung übergeht, zu grosser Vorsicht und ich werde daher auch die so eben aufgestellte Reihe nicht für völlig bewiesen halten, bevor ich nicht auch ein Glied der Meta-Rahe in gewöhnliche Phtalsäure werde übergeführt haben." Notwithstanding the fact that a great number of experiments were made with the object of more firmly establishing the principle adopted, by converting a member of the other series into the corresponding bibasic acid, they all failed; and the two analogous experiments of Meyer, viz., the conversion of sulphobenzoic acid into isophthalic acid, and the conversion of bromobenzoic acid into isophthalic acid, remained without support in their testimony. Attempts to apply the reaction to other fields were also unsuccessful, as shown in the experiments of Barth† and Ascher.‡ It is hardly strange, then, that with these circumstances the changes proposed by Meyer were not universally accepted; and those who opposed them on the ground that molecular re-arrangement might here play a *role* were certainly to some extent justified.

As I was now in possession of the para-acid§ corresponding to the meta-acid‖ with which Meyer performed his experiment, it became an interesting question as to what the conduct of this compound would be when fused with sodium formate.

From the pure acid barium salt the potassium salt was prepared, and, the directions of Meyer being closely followed, this salt was fused with an equal weight of pure sodium formate. In order to bring the mass to the point of fusion a comparatively high temperature was required. It then remained in a semi-liquid condition, apparently evolving gas for a short time, finally becoming much darker in colour—in fact nearly black. At a certain point volatile products, evidently containing sulphur, were given off, the odour of which was intensely disagreeable. The operation was performed in a silver crucible, and the mass constantly stirred with a silver spatula. Occasionally the vapours which were given off took fire above the crucible, and, on the gas-flame being now removed from beneath, and the flame of the vapour being extinguished, the mixture continued red-hot for a short time, presenting the appearance of a burning coal. When all had cooled down to the ordinary temperature, the crucible and contents were placed in water, and this boiled. The solution thus obtained was filtered, and, when cold, was treated with sulphuric acid. Thus was thrown down a very voluminous, flocculent precipitate, of a decidedly dark colour. In order to purify the product, it was filtered off, and well washed out with hot water; then dissolved in ammonia, and this solution boiled with animal charcoal. A nearly colourless solution resulted, and on treating this with sulphuric acid the precipitate formed was almost white. An attempt was made to prepare the barium salt by boiling with pure barium carbonate. After long-continued boiling with a large amount of water the acid had disappeared, and the salt was in solution. On evaporating gradually the salt was deposited in crusts during the process. It proved to be of exceedingly difficult solubility in water, boiling as well as cold. A small portion of it appeared to have a tendency to crystallise. This was separated from the powder and crusts, and repeatedly recrystallised. It was also very difficultly soluble in water, and yielded an acid which resembled terephthalic acid in some properties. By means of various reactions, however, it was soon proved that this was not one of the phthalic acids, and it seemed probable that it might represent a variety of the thihydrobenzoic acids, the formation of which has been shown* to take place in the reaction of Meyer for the preparation of isophthalic acid. The amount of the substance obtained was not sufficient to permit of its close examination, its perfect separation from the other substance formed being impossible. The difficulty of separation threatened at the outset to be a serious obstacle in the way of deciding the point under consideration. One method after another was tried, but the results were decidedly unsatisfactory, until finally the mixture was subjected to the influence of an oxidising agent (sulphuric acid and potassium bichromate). By this means the thihydrobenzoic acid (?) was so changed in character as to become soluble, whereas the other constituent of the mixture was left behind in a pure condition unacted upon. It was dissolved in ammonia, re-precipitated by means of a strong acid, filtered, and well washed out. In this condition it had the form of a very light, flocculent, white mass. It could be dissolved in boiling alcohol, and from this solution it was obtained in the form of microscopic needles which were deposited upon the sides of the vessel. This substance could not be brought to fusion. When heated in a capillary tube it sublimed from one part to the other before the flame, and was finally decomposed without fusing. It was almost absolutely insoluble in water, both boiling and cold; insoluble in ether. The pure substance could not be perfectly dissolved by boiling with barium carbonate. A small amount of the barium salt of the acid was, however, thus obtained, and this was very difficultly soluble in water, and did not crystallise. The calcium salt resembled this in every way.

These are the properties of terephthalic acid, with the exception of the conduct toward alcohol. To this I am not inclined to attach much weight, as the acid which is described as insoluble in alcohol is that which is obtained by oxidation of xylene, and the *condition* of this acid differs essentially from that of the light mass obtained by precipitating it from one of its salts. Further, I found that after being dried, the acid, as obtained by me, was also insoluble in alcohol. I would hence rather consider this conduct as indicating a property of terephthalic acid which had been overlooked. The substance was proved to have the composition of terephthalic acid by the following analysis:—

0·2325 grm. substance, dried over sulphuric acid, gave 0·4897 grm. CO_2 = 0·13355 grm. C and 0·0832 grm. H_2O = 0·00924 grm. H.

	Calculated.		Found.
C_8	96	57·83	57·44
H_6	6	3·61	3·97
O_4	64	38·56	
	166	100·00	

The proofs that terephthalic acid is formed when potassium parasulphobenzoate and sodium formate are fused together are thus conclusive. It remained, however, to show that neither phthalic nor isophthalic acid was formed at the same time. The crude product was boiled with water for a long time, and then filtered off. On allowing the filtrate to cool, a small quantity of substance was deposited in the form of powder. The whole was shaken with ether, which dissolved the powder and extracted whatever might be in solution. The original solution from which the crude acid had been precipitated was also treated with ether. On uniting the ethereal solutions and distilling off the ether, a residue was obtained which dis-

* *Berliner Berichte*, iii. jahrgang, 112.
† *Berliner Berichte*, iv. jahrgang, 634.
‡ *Ann. d. Chem. u. Pharm.*, clxi., 3.
§ Para 1·4. ‖ Meta 1·3.

* Ador, *Berliner Berichte*, iv. jahrgang, 622.

solved readily in alkaline carbonates. It was neutralised with barium carbonate. The barium salt was easily soluble and crystallised well. The free acid separated from this salt was easily soluble in hot water, and crystallised out on cooling. It had the fusing-point 120°, and all the other properties of *benzoic acid*. No other substance could be found. The quantity of benzoic acid obtained was very small in comparison to the whole quantity of the product, and its formation can easily be accounted for when we consider the character of the reaction.

Here then, at least, no molecular re-arrangement takes place; and this, taken in connection with Meyer's experiment, certainly makes the case strong enough to command attention. The reaction is thus shown to be capable of application for the purpose of determining the constitution of compounds, and the changes proposed by Meyer can be demanded with greater confidence than before. The proofs that paraoxybenzoic and terephthalic acids belong to the same series had already been given* by other reactions, though, acknowledging the described reaction, this would be the most direct proof of the fact.

(To be continued).

NOTICES OF BOOKS.

Practical Examples in Quantitative Analysis. By ERNEST FRANCIS, F.C.S., Demonstrator of Practical Chemistry, Charing Cross Hospital. London: H. K. Lewis, 136, Gower Street.

THIS small volume, as the author intimates in his preface, is intended for the use of medical students. It is undeniable that, if practising medical men are to fill the office of analysts under the "Public Health Act," they will certainly require a much more complete and practical knowledge of chemistry than they ordinarily possess at present.

The work treats of gravimetric, volumetric, and colorimetric analysis, the examples taken being the determination of total solids in water and in milk, of caseine in milk of total solids, uric acid and albumen in urine, of chlorides in water, of hardness in water, urea in urine, of sugar and of cream. In colorimetric analysis we find examples of the estimation of ammonia, ureal and albumenoid, and of nitrates and nitrites in potable waters. In estimating the hardness of water, we observe that the author adheres to Clarke's original method, in preference to the modification introduced by Wilson. The directions for the determination of organic impurities in water are sound, being taken from Messrs. Wanklyn and Chapman, and there is no attempt to lead the student into the unwholesome mysteries of "previous sewage contamination." It would scarcely be possible to compress a greater amount of useful matter into the small compass of 57 pages.

A Review of "Prof. Reese's Review" of the Wharton Trial. By Prof. W. E. A. AIKIN, M.D., LL.D. New York: D. Appleton and Co.

A CRITIQUE on the evidence given, and on the theories put forward, to establish the innocence of the defendant in a poisoning case, with general remarks upon certain points of medical—or we might say chemical—jurisprudence. Those who remember the Tawell and the Palmer trials in England, or who have read Prof. Taylor's remarks on the lines of defence then adopted, will fully appreciate the attack which Prof. Reese—a witness, or rather scientific advocate, for the defendant Wharton—thought proper to make upon Dr. Aikin.

* See V. Meyer, *Ann. d. Chem. u. Pharm.*, clvi., 267.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, April 28, 1873.

Methods for the Analysis of Water.—F. Tiemann.—The determination of hardness (magnesium) of sulphuric acid, nitrous and nitric acid, ammonia, sulphuretted hydrogen, and organic matter has led to constantly renewed discussion. Hence a re-examination of the methods recommended is desirable. *Determination of Hardness.*—The process for ascertaining the amount of alkaline earths in a water is always performed with a solution of soap, and depends on the double decomposition of the fatty alkaline salts in the soap, and of the lime and magnesia salts dissolved in the water. Insoluble lime and magnesia salts are separated out, and on shaking a froth is formed as soon as the decomposition is complete, and a slight excess of soap is present in the liquid. In the course of time three essentially different methods of determining the hardness by means of a soap solution have been made known; these are the old methods originally proposed by Clark, which has subsequently received several unessential modifications, the method of Boutron and Boudet, and that of Wilson. All three require that certain proportions of volume in respect of the quantity of water employed should be observed. It is in neither of these methods a matter of indifference whether—other conditions remaining unchanged—the hardness is determined in 10, 50, or 100 c.c. of water. All three render the determination of hardness possible only within certain limits, and in case of a very hard water require its dilution with distilled water to a normal volume. Clark, and the chemists who have slightly modified his process, use as standard test a dilute solution of soap, and a normal volume which some fix at 100 and others at 50 c.c. of water. As the consumption of soap-liquor in this method does not increase in the same ratio as the amount of calcic and magnesian salts present a table becomes necessary, showing the amount of soap solution corresponding to different degrees of hardness. Such tables, adapted to various conditions of concentration, have been drawn up by Clark, by Faisst and Knauss. The cause of the unequal decomposition of the soap-liquid may, perhaps, be found in the transient formation of soluble double compounds which at the outset of the process arise on the contact of soap and of the salts of the alkaline salts in very dilute solutions. In this manner the combination of an excess of the soap-liquid may be occasioned, and thus the latter may be deprived of the power of frothing when shaken. The alkaline salts (carbonates, sulphates, and chloride) formed in hard water on the decomposition of salts of alkaline earths by a larger amount of soap solution seem to diminish, and, finally, to hinder the formation of such double salts. The fact that highly concentrated neutral solutions of lime salts, mixed with soap, prevent it from frothing without giving an immediate precipitate (first pointed out by Maumené) agrees with this explanation. Boutron and Boudet avoid the above irregularities by applying a more concentrated solution of soap, and a normal volume of 40 c.c. of water. They use a peculiar measuring instrument (hydrotimeter) for reading off the concentrated test-liquid more easily. Its degrees do not correspond with the

cubic centimetres or its fractions. Wilson, who operates under conditions closely resembling those of Clark, obtains regularity of decomposition by adding 4 c.c. of a saturated solution of soda to the normal volume of 100 c.c. of water. In using Clark's process the author adopted the modification of Faisst and Knauss. 45 c.c. of soap solution correspond to 12 milligrms. of lime in 100 c.c. of water. The soap solution for the method of Boutron and Boudet was so arranged that the amount filling 23° of the hydrotimeter exactly sufficed to produce the well-known permanent froth in 40 c.c. of water in which a neutral salt of lime, equivalent to 8·8 milligrms. carbonate of lime has been dissolved. After deducting 1° of soap solution for the formation of froth 22° are employed in decomposing the 8·8 of lime salt in 40 c.c. water. 100 c.c. of the same water contain 22 milligrms. of carbonate of lime. The transformation taken as regular shows 1° soap-liquid to 1 milligrm. carbonate of lime in 100 c.c. of water. If the degrees consumed are multiplied by 0·56 we find the corresponding milligrm. of lime in 100 c.c. of water. The soap-liquid for Wilson's process was so arranged that 36 c.c. corresponded to 12 milligrms. lime in 100 c.c. of water which had been previously mixed with 4 c.c. solution of soda. In case of regular decomposition 3 c.c. solution of soap correspond to 1 milligrm. of lime in 100 c.c. of water. The hardness of a number of natural waters was determined according to these three methods. Some of the results are given below. In these and the following experiments the degrees of hardness are German, *i.e.*, units of lime in 100,000; only in one case, which is specially pointed out, are French degrees employed, *i.e.*, units of carbonate of lime in 100,000 parts of water :—

Total Hardness.

Water.	Clark.	B. and B.	Wilson.
I.	46·75	47·00	—
II.	6·16	6·90	6·20
III.	49·40	50·40	49·33
IV.	31·56	32·70	31·60

Permanent Hardness.

Water.	Clark.	B. and B.	Wilson.
I.	21·52	21·90	—
II.	1·90	1·20	—

The table of Faisst and Knauss was fully confirmed by the author's experiments. The procedure of Boutron and Boudet gives almost always higher numbers than the two other methods. In examining the method of Wilson we find that the addition of a saturated solution of carbonate of soda renders the decomposition of a soap solution by neutral salts perfectly regular. Wilson himself showed this in case of solutions of gypsum; and the author has experimented with a neutral solution of chloride of calcium, obtaining the following numbers :—

Water.	Carbonate of Soda.	Artificial Hardness.	Soap Liquid used.
100 c.c.	4 c.c.	12	36·0 c.c.
		9	27·0
		6	18·1
		3	9·2
		2	6·1
		1	3·3
		0·5	1·9
			0·6

With sulphate of magnesia the results are less favourable. Soap solution acts unequally quickly upon the compounds of the different alkaline earths and those of magnesia. Neutral salts of baryta are more readily decomposed than those of lime, and the latter more readily than magnesian salts. Equivalent quantities of calcium and magnesium compounds require for their decomposition exactly equal quantities of the same soap solution; but its action upon magnesian salts is not only much slower, but, if we do not work with very dilute solutions, incrustations and films are formed which prevent the portion of the magnesian salts still in solution from acting upon the soap. This difficulty is rightly regarded as a flaw in all determinations of hardness by means of soap. It is not very prominent in the method of Clark, nor in that of Boutron and Boudet so long as the normal volume of water is duly diluted with distilled water, and as only small quantities of the soap-liquid are added at once. In Wilson's process it is rendered formidable by the addition of the soda solution. The foam disappears towards the end of the process so slowly that it is doubtful whether the addition of soap-liquid should be continued or not. The hardness of a water rich in magnesian salts is, therefore, easily found too low by Wilson's method, as the following figures show. Three solutions were prepared, the artificial hardness of I. being 20°; of II., 6·5°; of III., 12°. The hardness of No. I. was caused by magnesia alone; that of II., 4·5° by lime and 2° by magnesia; that of III., 9° by lime and 3° by magnesia :—

	Clark.	B. and B.	Wilson.
I.	19·75	21·28	18·33
II.	6·45	6·86	5·66
III.	11·88	12·54	10·80

In case of Wilson's method the foam sometimes disappears after standing 15 to 20 minutes, and cannot be reproduced by shaking. Hence it appears that the original method of Clark is more accurate than either of the others, and is capable of the most general application.

Determination of Magnesia.—The quantity of magnesian salt existing in solution in a water can be approximately estimated from the difference between the total hardness and the amount of lime as found by Mohr's process (titration with oxalic acid and permanganate), the number obtained being reduced to its equivalent in magnesia by multiplication by $\frac{4}{7}$ths. The error occasioned by free carbonic acid—which also decomposes the soap solution—is neglected. In the author's experiments this amount was very trifling. The method of determining magnesia in a water by soap-liquid, after previous boiling and removal of the lime salts with oxalate of ammonia, cannot be pronounced trustworthy. It yields results which sometimes agree closely with those obtained gravimetrically, but on other occasions differs unaccountably.

Contribution to our Knowledge of the Ashes of Vesuvius.—C. Osterland and P. Wagner.—The sample analysed contained :—

Silica	47·53
Alumina	24·95
Iron (peroxide)	4·90
Iron (protoxide)	3·60
Magnesia	3·33
Lime	12·85
Potash and soda	1·41
Phosphoric acid	0·90
	99·47

Traces of sulphur and sulphuric acid were also present.

Preparation of Iodphosphonium.—A. W. Hofmann.

Phosphines of the Propyl-Butyl and Amyl Series.—A. W. Hofmann.

Formation of Phosphines under Co-Operation of Reduction Processes.—A. W. Hofmann.

Further Observations on the Phosphinic Acids.—A. W. Hofmann.

These four papers are reserved for extended insertion.

On Propylen Diamin.—A. W. Hofmann.—The author prepares propylen diamin by acting with ammonia upon the bromide of propylen in sealed tubes, and afterwards, on the large scale, in an enamelled iron digester. Part of the liquid obtained was filtered from the deposit of bromide of ammonium, and digested with oxide of silver. A strongly alkaline liquid was obtained, in which, after the ammonia and alcohol had been expelled, chloride of platinum gave a pale yellow precipitate, perfectly in-

soluble in water. The rest of the liquid was treated with excess of solid potash, and heated in a retort to expel ammonia and alcohol. Propylen diamin was obtained as an oily liquid. After it had come over, less volatile bases made their appearance, secondary and tertiary diamines and triamines. Pure propylen diamin is a colourless, transparent, not very mobile liquid, boiling at 120° C. It consists of—

Carbon	48·64
Hydrogen	13·52
Nitrogen	37·84
	100·00

And its formula is $C_3H_{10}N_2$. Its affinity for water and for carbonic acid is remarkable.

Certain Carbonic Acid Derivatives of Isobutyl.—E. Mylius.—The compounds described are sulphoethyl-dioxy-carbonate of butyl, sulphobutyl-dioxy-carbonate of ethyl, trisulphocarbonate of butyl, and butyl-trisulphocarbonate of soda.

Action of Chlorine upon Isobutyl Aldehyde.—G. A. Barbaglia.—The author attempted to prepare a monochlorated compound, analagous to Schrœder's monochloro-valeraldehyde, but obtained a substance having the composition C_3H_5ClO, and approaching more nearly to monochloraceton and epichlorhydrine.

Oils of Mustard.—Eugene Dell.—A preliminary notice.

Kresotenic Acid.—R. Biedermann and W. Pike.—The material employed by the authors was cresol, in which sodium was dissolved under simultaneous introduction of a stream of carbonic acid gas. The pure acid obtained fuses at 174° C.; crystallises from hot water in fine shining needles, closely resembling salicylic acid. It takes a deep violet colour on contact with chloride of iron.

Certain Derivatives of Cresol.—R. Biedermann.—The author attempted to obtain substitution products with chlorine, and formed a monochloro-cresol, C_7H_7ClO, fusing at 56° and volatilising undecomposed at 240° C. This substance gives few reactions. It was not found possible to obtain from it orcin or any isomeric body by fusion with potassa or by boiling with alcoholic potassa. Cresol-sulphuric acid was prepared, and its potash-salt fused with potassa gave indications of proto-catechucic acid. The production of orcin was next attempted by means of iodides of cresol. Proper quantities of iodic acid and iodine were dissolved in dilute alkali, and the theoretical amount of cresol was added. A yellowish-red body was ultimately obtained, which, with ammonia, took a red colour like orcin, and dissolved in fixed alkalies with a deep red colour. It did not yield the deep violet colour with perchloride of iron, and the results on analysis did not agree with orcin.

New Members of the Stilben Group.—Julius Strakosch.—This paper gives an account of the preparation and properties of dinitro-stilben, amido-nitro-stilben, and diamido-stilben.

Contribution to the History of the Thio-amides.—R. Wanstrat.—The author has studied the action of iodine upon thio-cuminamide, amidothio-benzamide, and the action of nascent hydrogen upon the product resulting from the treatment of thio-cuminamide with iodine.

Contributions to the History of the Derivatives of Salicylic Acid.—R. Wanstrat.—An account of the preparation and properties of salicylic acid-anilide, salicylic acid-nitranilide, and salicylic acid-toluidide.

Derivatives of Salicyl-Aldehyde.—W. Haarmann.—Salicyl-aldehyde agrees with the remaining aldehydes in its behaviour with substituted ammonia. Salicyl-anilide, $C_{13}H_{11}NO$, has been previously obtained by Schischkoff, with separation of water on heating together equal volumes of aniline and salicyl-aldehyde. The author obtained monobrom-salicylanilide by acting with aniline upon monobrom-salicylaldehyde under the same conditions. It crystallises from alcohol in brick-red needles, and consists of $C_{13}H_{10}BrNO$. Anhydrous hydrocyanic acid reacted violently with a mixture of salicyl-aldehyde and aniline. The result was hydrocyanate of salicyl-anilide, in pure white crystals insoluble in water, but readily soluble in alcohol and ether. On exposure to the air, it becomes light red without decomposition; but if exposed to a continuous heat of 100° C. it is resolved into hydrocyanic acid and a resinoid residue. Its composition is $C_{14}H_{12}N_2O$. Salicyl-paranitranilide is formed by the action of paranitraniline on salicyl-aldehyde. It forms pale yellow crystalline needles, which melt at 115° C. An attempt to combine this body with hydrocyanic acid yielded a bright red substance fusing at 205° C., insoluble in water, and sparingly soluble in boiling alcohol and ether. The action of ammonia and hydrocyanic acid upon salicyl-aldehyde was also examined, the result being a red crystalline body of the composition $C_{29}H_{21}N_3O_3$.

Transformation of Naphthylamine into Nitro-naphthal.—G. Andreoni and R. Biedermann.—A preliminary notice. Naphthylamine is first converted into aceto-naphthylamine. From this mononitro-acetonaphthylamine is obtained, which, by the action of alkalies, becomes mononitro-naphthal.

The Sulphacids of the Methylanilines.—G. A. Smyth.—The author has examined the behaviour of methyl-aniline and dimethylaniline with sulphuric acid. The monosulphacid of dimethylaniline is a crystalline substance of the composition $C_8H_{13}NSO_4$.

New Series of Diamines which Occur as By-Products in the Manufacture of Methylaniline.—A. W. Hofmann and C. A. Martius.

The Violet Colour-Derivatives of the Methyl anilines.—A. W. Hofmann.—These two long and important papers are reserved for full insertion.

Constitution of the Benzol Substances.—Theodore Petersen.—A theoretical, not to say hypothetical, paper, consisting to a great extent of "graphic formulæ."

Aromatic Compounds Containing Silicium.—A. Ladenburg.—The author has formed and examined silicium-phenyl trichloride, ortho-silico-benzoic ether, and silico-benzoic acid, both anhydrous and hydrated.

Derivatives of Cœrulignon.—C. Liebermann.—The author has previously described cœrulignon as a by-product obtained in the purification of wood vinegar, and belonging to the chinon class. He has now investigated the constitution of the substance, and has formed some of its derivatives and reactions.

Constitution of the Allyl Compounds.—A. Kekulé and A. Rinne.—Allyl alcohol is readily attacked by dilute chromic acid. Even in the cold the odour of acrolein is observed, and carbonic acid escapes. If the liquid is distilled, after some time formic acid is detected in the distillate, but not acetic acid. If the same alcohol is treated with nitric acid, there is no odour of acrolein. Formic acid without acetic appears in the distillate, and there is much oxalic acid in the residue. The behaviour of the iodide and cyanide of allyl with chromic and nitric acids was also examined.

On a Compound of the Cyanide of Allyl and Ethylic Alcohol.—A. Rinne.—The new compound consists of C_4H_5N,C_2H_6O. Its boiling-point is between 173° and 174°.

A New Formation of Stilben.—Br. Radziszewski.—Phenyl-acetate of baryta with a slight excess of sulphur was submitted to dry distillation. The distillate contained a hydrocarbon, which, when purified and examined, proved to be stilben. The yield is abundant.

On Graphite.—J. Stingl.—(See p. 264.)

On Ortho-Nitrophenol Sulphacids, Amidophenol Sulphacids, and a new Nitrophenol.—Jul. Post.—A preliminary notice. The author reviews the results of

previous experimentators and announces the discovery of four amido-sulph-phenols.

On Chinon Substances. — Th. Petersen.—A theoretical paper, which would not be intelligible without the accompanying diagrams.

Hydrates of Monobasic Acids. — A. Geuther. — A controversial essay directed against Messrs. Grimaux and Henninger. The author considers that it is not his fault if his results, published three years ago, have not become known to these gentlemen.

Remarks on H. Fudakowsky's Paper "On Slow Oxidation as an Agent for rendering Oxygen Active."—Ed. Schaer.—The author confirms the facts cited by Fudakowski. He states that not alone insulation promotes the slow oxidation of the hydrocarbons and the simultaneous ozonisation of oxygen, but that heat, within certain limits, has the same influence. During a series of experiments performed in the year 1866, with the view of confirming Schœnbein's results on the antozone present in resins, he (Schaer) proved that on carefully distilling, in a place sheltered from direct light, a mixture of water with oil of turpentine, of juniper, of lemon, and other terebenes in a relatively large volume of air, both the distillate and the watery layer of the residual matter give unmistakeable indications of the presence of peroxide of hydrogen ; whilst the oil, which has passed over, behaves as if it had been exposed for some time to the action of oxygen under the influence of light. Schœnbein considers this behaviour of the essential oils with oxygen as a main support of his doctrine of the polarisation of oxygen. It may perhaps be assumed—without prejudicing the existence of antozone, so often asserted and so often denied—that the differentiation of oxygen occurs in all cases of slow combustion, that is, whenever air and water act upon organic or inorganic materials.

Derivatives of Bromtoluol as Evidence concerning the Nature of the Bromtoluols.—H. Huebner and P. Hässelbarth.—A table of the formulæ and properties of the parabromtoluol sulphuric, and parabromnitrotoluol sulphuric β and α compounds.

Oxidation Products of Colophonium.—Jos. Schreder.—A preliminary notice. The author is examining the oxidation products of the so-called turpentine-resins, which, unlike the aromatic and the umbelliferous resins, are not attacked and decomposed by melting alkalies, but are oxidised by nitric acid forming acids not yet studied. Colophonium yields isophthalic and trimellitic acids.

Monobasic Saccharate of Lime. — R. Benedikt. — The author has succeeded in preparing a salt, to which he assigns the formula $C_{12}H_{20},CaO_{11}$, and which contains—

Calcium	10·80
Carbon	37·44
Hydrogen	5·57
Oxygen	46·19
	100·00

Diphenyl-benzol.—G. Schultz.—When benzol is passed through incandescent tubes, we obtain along with diphenyl several bodies boiling at higher temperatures. Berthelot has isolated three of these, and distinguished them as—chrysen, benzerythren, and bitumen. The author considers that Berthelot's chrysen is diphenylbenzol, its analysis showing $C_{18}H_{14}$, whilst the formula of chrysen is $C_{18}H_{12}$.

Synthesis of Aromatic Acids.—W. Weith.—The author recently made known that on treating phenylated oil of mustard with powdered copper, cyanphenyl is formed by the removal of sulphur, and passes into its isomer benzonitril. He has subsequently discovered that the above reaction is generally applicable, and that the isomeric tolyl mustard-oils are easily transformed into the corresponding nitriles. In this manner, pseudotoluidine is converted into orthotoluilic acid, and solid toluidine into paratoluilic acid.

Brüning's New Method of Preparing Magenta.—Coupier.—The author claims priority in the preparation of magenta, by treating aniline with nitro-benzol.

A Question of Priority concerning some Thermo-Chemical Laws.—J. Thomsen.—The author considers that Berthelot and others are claiming and receiving the credit of having made certain generalisations which he himself announced several years previously.

Affinity of Oxygen for Chlorine, Bromine, and Iodine.—J. Thomsen.—An examination of the amount of heat liberated during the formation of chloric, bromic, iodic, hypochlorous, and periodic acids.

New Universal Support.—R. Muencke.—The construction and uses of this piece of apparatus could not be understood without the accompanying illustration.

New Conversion of Oil of Turpentine into Cymol.—A. Kekulé.—Iodine was added to the oil of turpentine-oil in small successive portions, the reaction being each time assisted towards the end of heat before a fresh quantity was added. In this manner 10 grms. of cymol were obtained from 50 grms. oil of turpentine and 22 grms. of iodine.

Bulletin de la Société Chimique de Paris, tome xix., No. 10, May 20, 1873.

Binitro Compounds of the Higher Homologues of Benzol.—A. Rommier.—In his previous investigations, the author obtained from the oils of coal two xylenes, one of which was soluble in sulphuric acid of ordinary concentration, and the other insoluble. The soluble xylene yielded, with fuming nitric acid, two binitro compounds, the mixture of which melted at 61° C. These two bodies, re-crystallised from alcohol, have been investigated by Des Cloizeaux, who found that the less soluble binitro-xylene, α, formed crystals belonging to the clino-rhombic system, whilst the more soluble binitro-xylene, β, formed rhombic crystals of the triclinic system. On further examination it was, however, found that the salt β, on repeated crystallisation, was transformed into α. The author concludes, therefore, that there is merely a single binitro compound corresponding to the xylene soluble in sulphuric acid. To sum up: by the action of ordinary sulphuric acid upon the oils of coal, we separate two xylenes, two cumenes, and two cymenes:—I. Hydrocarbides insoluble in sulphuric acid, accompanied by a certain quantity of formenic hydrides. (1). Xylene, boiling between 139° and 140° ; its binitro compound melts at 92°, and forms clino-rhombic crystals. It differs from the binitro methyl-toluen of Fittig, which forms two kinds of crystals, the less soluble in long colourless needles, melting at 123·5°, the other in brilliant, transparent, monoclinic crystals, fusible at 93°. (2). Mesitylene, boiling at 165° to 167°, is the most abundant member of the series ; its presence in coal oils was shown by Fittig, and its binitro compound examined by Des Cloizeaux. (3). Cymene, according to theory, should boil at 196°, the gradation of boiling-points between benzol and its homologues being 28° to 29°. Its direct verification did not succeed, from the presence of formenic hydrides boiling at adjacent temperatures. II. Hydrocarbides soluble in sulphuric acid and regenerated by distillation. (1). Isoxylene, boiling at 139° to 140°. Its binitro compound melts at 92° to 93° ; very fragile prisms. (2). Pseudocumene, boiling at 165° to 167°, and forming two binitrocumenes fusible at 86°. (3). The cymene of this series is contaminated with naphthaline.

On Aniline Black.—Ch. Lauth.—(See p. 275).

Reply to the last Communication by M. Berthelot on the Mercurial Calorimeter.—P. A. Favre.—A continuation of the controversy between these two *savants* (see vol. xviii., p. 388).

On Silk Dyeing, and on the Combination of Silk with Sulphuric Acid.—M. E. Durrwell.—The author takes, for the foundation of his views, the hypothesis that silk forms, with acids, true compounds, capable of uniting with the coal-tar colours and with other dyes. Having ungummed silk to set the fibroine at liberty, he boiled it for a day in distilled water, to remove the last traces of the soap employed in this operation. It was then extracted with alcohol, so as to leave pure fibroine, which invariably gave an alkaline reaction. This silk was then dyed in a bath of litmus and very dilute sulphuric acid. The litmus serves here at once as reagent and as colouring matter. The colour is thus entirely fixed in the silk; but, on neutralising the bath with a trace of magnesia or of caustic soda, the blue litmus went back into solution, except a trace which was still absorbed by the silk. This experiment may be indefinitely repeated on the same colour-bath by rendering it alternately acid or neutral. It is the same with the coal-tar colours, but, as these have a great tinctorial power, the experiment is less striking and decisive than with litmus. On treating 2 parts of fibroine with 1 part of sulphuric acid in the cold, combination at once takes place. Heat is developed, which must be kept down as much as possible by cooling the capsule, otherwise the silk will be completely resolved into glucose and ulmic compounds. After an hour's time, the reaction is complete. The brown liquid is filtered over asbestos, diluted with three or four times its bulk of water; the excess of acid is neutralised with baryta, filtered, and evaporated. A mass is thus obtained which, on treatment with alcohol, leaves a true compound of fibroine and of sulphuric acid. It is a white, transparent, horn-like body, soluble in water. The solution, if treated with an alkali, gives a precipitate of fibroine.

Bulletin de l'Academie Royale des Sciences des Lettres et des Beaux-Arts de Belgique, No. 4, 1873.

Note on a Fossil Bird discovered in the Rupel Clay.—P. J. van Beneden.

New Process for Preventing Ships' Compasses being affected by the Iron and Steel which is employed in the construction, as well as occasionally carried as cargo by the vessels.—M. Glœssner.

Revue Scientifique de la France et de l'Etranger, No. 47, May 24, 1873.

This number contains no original chemical matter.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Mène, No. 19, March 13, 1873.

Delaunay's Apparatus for the Alcoholometric Assay of Wines.—The specific gravity of the wine is taken in its ordinary state. Another equal portion of wine is boiled in a flask till all the alcohol is expelled and the thermometer immersed in it rises to 100° C. The boiled liquid is then put into the hydrometer glass, made up to its original bulk with distilled water, and its specific gravity again determined. From the difference of these two specific gravities (before and after the expulsion of the alcohol) the amount of alcohol is found by means of tables accompanying the apparatus. It is necessary that the temperature of the wine should be 15° C. If it be higher or lower corrections are required.

No. 20, March 20, 1873.

This number contains nothing touching in the remotest manner upon chemistry.

No. 21, March 27, 1873.

Galzy's Insecticide.—A laudatory notice of an insecticide of unknown origin.

New Mode of Preserving Organic Substances from Decay.—M. Lanjorrois.—The author proposes to add to the substances to be preserved 1 per cent of magenta! The process has been applied to slices of beef, which, after being kept for several months, yielded—after being washed and boiled—very good soup. (Should this method of preserving food become general, we trust that the magenta employed will be free from arsenic).

MISCELLANEOUS.

Memorial to Justus Liebig.—Many of our readers will be glad to know that at a meeting of the German Chemical Society, held in Berlin, on April 28th last, it was resolved to erect a statue in honour of the late illustrious chemist, Baron Liebig, and to invite his pupils, friends, and chemists of all nations, to contribute towards the funds necessary for that object. Drs. Warren de la Rue, Frankland, Gilbert, Odling, Stenhouse, and Williamson, are members of the Committee, and communications and subscriptions may be sent to Dr. Hugo Müller, 110, Bunhill Row, E.C.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the means of and apparatus for removing obstructions from gas-pipes. George Goldsmith and James Dilkes, Leicester. November 4, 1872.—No. 3269. The object of this invention is to afford means for clearing gas-pipes, especially services, and consists in forming a plug furnished with a barrel which is to be filled with gunpowder and inserted in the offending pipe. The charge is then to be fired by striking a percussion-cap placed on a nipple on the outside of the plug, when an explosion ensues and the removal of any obstruction is the result.

The manufacture from mahogany and other woods of a colouring matter similar to cashoo. Charles Rave, merchant, Cureghem-les-Bruxelles, Belgium. November 4, 1872.—No. 3270. This invention consists in extracting from mahogany and rose woods a matter having all the properties of the brown cashoo of commerce. The matter is obtained by first reducing the wood to powder, then roasting or torrefying the powder, afterwards washing and boiling it, and finally concentrating it by evaporation into a syrupy or a dry state.

Improvements in cements. John Railton Williams, merchant, Manchester, Lancaster. November 4, 1872.—No. 3272. This invention consists in mixing powdered zinc with cement.

Improvements in obtaining anthracene and in apparatus connected therewith. John Berger Spence, merchant, Manchester, Lancaster. (A communication from Jos. C. F. Cheever, New York, United States of America). November 4, 1872.—No. 3273. This invention consists of a pitch tank, tempering reservoir, still, and condensor, for the purpose of obtaining anthracene from coal-tar pitch by a continuous process.

Improvements in treating and utilising certain refuse animal and vegetable substances, and the application of the resulting substances or matters to various manufactures. William Glazier, 235, Drake Street, Rochdale, Lancaster. November 5, 1872.—No. 3278. This invention consists in utilising scrap leather and the fibrous refuse from wool, cotton, flax, and jute manufactures and spent dye-woods by combining these materials with silicates, animal carbon, gas-tar, asphalt, and bitumen in the several ways described in the Specification so as to make an improved plastic composition and also various kinds of waterproof and fireproof goods and vessels. The leather is first treated with a hot solution of alkali, and then subjected to the action of steam or boiled in water under pressure until it is reduced to a gelatinous mass, to which is added glycerine and pyroligneous acid. To this mixture is added a solution of pyroligneous acid and tannic acid or of pyroligneous acid and alum. The whole is then thinned with boiled oil and mixed with mineral oxide, or dry silicate colours. This mixture is called the "cementing mixture." By adding to this mixture the fibres hereinbefore referred to, a plastic composition or pulp is made, which may be rolled, moulded, or otherwise formed into various useful and ornamental articles. In making "shaped" felted articles the fibres are first disintegrated or devilled, then deposited on moulds and the shapes saturated with the cementing mixture. In making composite sheets or slabs the devilled fibres are felted into sheets, which sheets are saturated with the cementing composition, then coated with the plastic composition. The whole is then pressed, after which, should the slab not be sufficiently thick, other saturated sheets are placed on the first until the slab is made of the required thickness. In making waterproof slabs or sheets the felted sheets are saturated, as before described, pressed, and dried; then coated with a waterproofing composition of ground carbon and gas-tar mixed with naphtha or turpentine or benzine, and are covered with melted asphalt or bitumen, on which a second prepared sheet is placed and the whole

pressed together. The waterproofing composition above described is applicable to the protection of iron from rust and also to the coating of vessels and articles made according to this invention. In making floor-cloth the "cementing composition" is mixed with silicate pigments, cotton fibres, spent dyewoods, and ground cork and spread on the felt. In making tesselated floor-cloth or imitation parquetry the sheets of felt are saturated with the cementing composition and coloured according to the pattern required. The pieces constituting such pattern are then cut out and affixed to a sheet of felt or canvass by means of the cementing composition. In making circular and other shaped receptacles, tubs, "skips," boxes, tanks, and cisterns, a shape is made by cementing brown paper on a suitable mould. The shape is then coated with the cementing composition and when dry coated with the plastic composition hereinbefore described, after which it is again dried and pressed and finished by coating with the waterproof composition. Where great strength is required, strips of calico are affixed around the vessel. The waterproofing and cementing compositions hereinbefore described are applicable to the preservation of iron ships.

Improvements in artificial fuel, part of which improvements having reference to the means or apparatus employed in the manufacture of the same. Edward Joseph William Parnacott, engineer, Leeds. November 6, 1872.—No. 3292. The employment of powdered, dissolved, or liquefied waste caoutchouc or gutta-percha for fuel either separately or in combination with other substances such as clay, road mud, fine riddlings or small coal or dust of coke, also shale, peat, and sawdust; these are thoroughly mixed or agglomerated in a pug-mill, and afterwards moulded into any required form in a brick-machine of ordinary construction, and afterwards dried.

NOTES AND QUERIES.

Formic Acid.—Will any of your readers inform me whether commercial formic acid, formiate of lead, or any other formiate is used for dyeing or any other process in the arts ?—S. S.

"Experiments with the Torsion-Rod for Determining the Mean Density of the Earth," forming vol. xiv. of the *Memoirs of the Royal Astronomical Society*. By Francis Baily, Esq., Vice-President of the Society. London. 1843.

P. 43.—"The torsion-rod is never at absolute rest, but is constantly in a state of vibration on its centre; and consequently when the end of it is viewed at a distance with the telescope, it appears to oscillate on each side of a mean point, called the *resting point*."

"This resting point, however, is by no means permanent or stationary, and seldom remains in the same position for any length of time, even when the torsion-rod is not influenced by the approach of the masses. The extent and direction of its disturbance, as well as its rate of motion when so disturbed, are very variable, and seem to depend on causes which have not been sufficiently accounted for, but which may in some measure arise either from slight changes of temperature, or some latent alteration in the component parts of the suspension line."

P. 44.—" . . . It must be confessed, however, that discordances sometimes arise which cannot wholly be attributed to change of temperature, but to some other occult influence with which we are at present unacquainted."

P. 64.—"Seeing that the results came out nearly the same, with the same balls, in whatever way the experiments were varied, I next tried the same plan with the glass balls, the single results of which . . . . had been somewhat more discordant, and the mean result somewhat greater, than the results obtained by the other balls. . . . . I was agreeably surprised at finding the single and daily results in such good accordance with each other, ... although I was still at a loss to account for the slight difference which still existed between the results with these balls and the heavier ones."

"I next tried what the result would be with balls made of a substance still lighter than that of glass. I therefore . . . . affixed the 2 inch ivory balls. . . . . the mean result agrees very well with the general result of the experiments previously made with the 2 inch lead balls; although it is somewhat less than that deduced from the experiments made with the glass balls, which was contrary to my expectations."

P. 65.—"Conceiving that there might be some unexplained cause even for this slight discordance, I resolved to repeat the experiments under the same circumstances. . . . . The mean result was still less than in the former series. I am unable to account for the cause of this discordance in any other way than by the known fact that in all cases, where the deviation is so small, ... a slight variation in the position of the resting point makes a considerable difference in the resulting density. . . . . But, in the present instance, the single and daily results are in very good accordance with each other. . . . Some other varying force, therefore, would seem to be in operation.

"Wishing however to ascertain whether a similar diminished result would be produced by a repetition of the experiments with the glass balls, I again submitted them to another trial. . . . . the mean result showed that the same diminished difference had here also been produced as . . . . with the ivory balls; and for the cause of which I cannot account in any other way than that to which I have just alluded."

P. 67.—"I am still however unable to assign any satisfactory reason why the mean result of these heavy balls should be so much less than that of the lighter balls. There is nothing on the face of the experiments that indicates any cause for a suspicion of error, and therefore we must look for some other explanation."

MEETINGS FOR THE WEEK.

MONDAY, 9th.—Geographical, 8.30.
TUESDAY, 10th.—Photographic, 8.
WEDNESDAY, 11th.—Society of Arts, 8.
—— Geological, 8.
THURSDAY, 12th.—Royal, 8.30.
—— Royal Society Club, 6.
FRIDAY, 13th.—Astronomical, 8.
SATURDAY, 14th.—Quekett Microscopical Club, 8.

TO CORRESPONDENTS.

*** Vol. XXVI. of the CHEMICAL NEWS, containing a copious index, is now ready, price 11s. 4d., by post, 12s., handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxvii. commenced on Jan. 3rd, and will be complete in twenty-six numbers. READING CASES, price 1s. 6d. each, post free, may also be obtained at the Office.

D. McPherson.—See No. 683.
W. B. M.—Received with thanks.

BOOKS RECEIVED.

Manual of Chemical Analysis as Applied to the Examination of Medicinal Chemicals. By Frederick Hoffmann, Ph.D.—New York: D. Appleton and Co.

Practical Examples in Quantitative Analysis. By Ernest Francis, F.C.S.—London: H. R. Lewis.

Notes of a Course of Nineteen Lectures on Natural Philosophy. By G. F. Rodwell, F.R.A.S., F.C.S.—J. and A. Churchill.

Third and Fourth Annual Reports of the Geological Survey of Indiana, made during 1871 and 1872 by E. T. Cox.—Indianapolis: R. J. Bright.

Maps for Geological Survey of Indiana, 1872. By E. T. Cox.

Utilisation of Sewage and Purification of Streams.—The General Sewage and Manure Company, Limited, is prepared to Negotiate with the Authorities of Towns for the Treatment and Disposal of the Sewage of their Districts.—By order,

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THE CHEMICAL NEWS.

VOL. XXVII. No. 707.

ON THE ACTION OF HYDROCHLORIC ACID ON CODEINE.

By C. R. A. WRIGHT, D.Sc.,
Lecturer on Chemistry in St. Mary's Hospital Medical School.

In a former paper, written in conjunction with E. L. Mayer (*Chem. Soc. Journ.*, [2] xi., 211), it has been shown that when morphine is treated with hydrochloric acid at 100° the first action that takes place is, apparently, the addition of the elements of hydrochloric acid; the subtraction of the elements of water taking place subsequently, bases being formed of the composition—

$(\overline{M} = C_{34}H_{36}N_2O_5)$

(P). $\overline{M} + HCl$

(Q). $\overline{M} + HCl - H_2O$

(R). $\overline{M} + 2HCl - 2H_2O$

A base homologous with the last one has been obtained already from codeine, viz., the so-called "chlorocodide" obtained by the late A. Matthiesen and the author (*Proc. Roy. Soc.*, xviii., 83). In order to trace out more completely the history of the formation of this base and its subsequent decompositions, codeine was heated on the water-bath for two and a half hours with from 6 to 8 parts of strong hydrochloric acid; a less time of digestion being found to give too little product for successful isolation. The resulting acid liquid was nearly neutralised by caustic soda, and precipitated by sodium carbonate, which threw down a white amorphous precipitate; this was separated by filtration, dissolved in hydrochloric acid, again precipitated by sodium carbonate to remove traces of codeine, and finally dissolved in ether. The ethereal solution yielded a viscid non-crystalline hydrochloride on agitation with a few drops of hydrochloric acid. In physical properties this exactly resembled "chlorocodide" hydrochloride: but on analysis it yielded numbers indicating the presence of a less chlorinated base as well—

0·3005 grm. gave 0·673 CO_2, and 0·166 H_2O
0·3165 ,, ,, 0·229 AgCl.

These numbers agree with the composition—

$9(C_{36}H_{42}N_2O_6,2HCl) + 14HCl - 10H_2O$;

which represents a mixture of the hydrochlorides of two bases homologous with (P) and (R) derived from morphine as above mentioned—

	Calculated for $\begin{cases} 4C_{34}H_{38}ClNO_{10},2HCl \\ 5C_{36}H_{43}Cl_2NO_{11},2HCl \end{cases}$	Found.
Carbon	61·04	61·08
Hydrogen	6·12	6·14
Chlorine	17·83	17·90

Hence, writing $\overline{C}$ for $C_{36}H_{42}N_2O_6$, the formation of these bases may be expressed thus:—

$$\overline{C} + 3HCl = \underbrace{(\overline{C} + HCl),2HCl}_{\text{Homologue of (P) from Morphine.}}$$

$$\overline{C} + 4HCl - 2H_2O = \underbrace{(\overline{C} + 2HCl - 2H_2O),2HCl}_{\text{Chlorocodide.}}$$

It thus appears that the formation of "chlorocodide" is preceded by that of a base containing only 1 proportion of chlorine to 36 of carbon, and, hence, "chlorocodide" must be represented by a C_{36} formula at least; but as ordinary codeine is obtained from "chlorocodide" by the action of water (Matthiesen and Wright, *Proc. Roy. Soc.*, xviii., 83), it appears that "chlorocodide" is a derivative of ordinary codeine and not of any of its higher polymerides, and hence that ordinary codeine must have a C_{36} formula too.

When the action of hydrochloric acid at 100°, or slightly higher, (the liquid being kept *very* gently boiling) is carried on for a longer time methyl chloride is evolved; but after a time this ceases, and after 10 hours or so all the codeine has become converted into a mixture of two isomeric bases of composition intermediate between that of morphine and that of "apomorphine." One of these bases is soluble in ether, and yields crystalline salts much resembling those of apomorphine; the other is insoluble in ether, and belongs apparently to the tetra series.

The product of 10 hours' action of hydrochloric acid was precipitated by sodium carbonate, well drained on filters, and digested with ether. The ethereal solution agitated with hydrochloric acid gave a crystalline hydrochloride, which gave the following numbers after recrystallisation:—

0·3065 grm. gave 0·7380 CO_2 (H_2O lost).
0·2255 ,, ,, 0·5350 CO_2 and 0·132 H_2O.
0·1015 ,, ,, 0·0480 AgCl.

		Calculated.		Found.	
C_{68}	816	65·28	65·65	64·71
H_{76}	76	6·08	—	6·50
Cl_4	142	11·36	11·69	
N_4	56	4·48		
O_{10}	160	12·80		
$C_{68}H_{72}N_4O_{10},4HCl$	1250	100·00		

The portion insoluble in ether was dissolved in hydrochloric acid, and fractionally precipitated by sodium carbonate to remove colouring matters. Finally a non-crystalline hydrochloride was obtained which gave the following numbers after drying at 100°:—

0·2980 grm. gave 0·716 CO_2, and 0·170 H_2O.
0·2980 ,, ,, 0·1365 AgCl.

	Calculated.		Found.
C_{136}	1632	65·28	65·52
H_{152}	152	6·08	6·34
Cl_8	384	11·36	11·33
N_8	112	4·48	
O_{20}	320	12·80	
$C_{136}H_{144}N_8O_{20},8HCl$	2500	100·00	

From its physical properties it appears probable that ths base forming the crystalline hydrochloride belongs to the series of derivatives from the *double* polymerides (dicodeine, "apomorphine," &c.); hence it is viewed as having a C_{68} formula, and as possessed of the composition of the "diapo" derivative of (hypothetical) dimorphine, *i.e.*, as $\overline{M}_2 - 2H_2O$. Hence it may be conveniently termed *diapo-dimorphine*.

Similarly, the isomeric base insoluble in ether produced simultaneously evidently belongs to the tetra series, and hence may be conveniently termed *tetrapo-tetramorphine*, having the composition $\overline{M}_4 - 4H_2O$, and a C_{136} formula.

Both compounds give a blood-red colouration with nitric acid, a lighter evanescent red with sulphuric acid and potassium dichromate, and a dirty purple with ferric chloride. They may be viewed as produced by the mutual reaction, polymerisation, and demethylisation of the two bases first formed by the action of hydrochloric acid on codeine, viz., the homologues of (P) and (R) similarly obtained from morphine.

$$\underbrace{(\overline{C} + HCl)}_{\text{Homologue of P.}} + \underbrace{(\overline{C} + 2HCl - 2H_2O)}_{\text{"Chlorocodide."}} + HCl =$$

$$= 4CH_3Cl + \underbrace{(\overline{M}_2 - 2H_2O)}_{\text{Diapodimorphine.}}$$

$$\underbrace{2(\overline{C}+HCl)}_{\text{Homologue of P.}} + \underbrace{2(\overline{C}+2HCl-2H_2O)}_{\text{"Chlorocodide."}}+2HCl=$$

$$=8CH_3Cl + \underbrace{(\overline{M}_4-4H_2O)}_{\text{Tetrapotetramorphine.}}$$

where $\overline{C}=\overline{M}+2CH_2=\overline{M}+2CH_3-H_2$, *i.e.*, where codeine is dimethylated morphine.

It has been formerly shown* by the late A. Matthiesen and the writer that when either "chlorocodide" or codeine is heated to 140° to 150° under pressure with excess of strong hydrochloric acid methyl chloride is formed, and apomorphine apparently identical with that from morphine is produced. It thus appears that the action of hydrochloric acid on codeine at 100° is different from that at 140° to 150°, the elements of two proportions of water (per C_{68}) being removed in the first case, and those of four proportions in the second, diapodimorphine, and tetrapodimorphine being respectively formed. These two bodies are alike in physical properties and qualitative reactions, but they differ much in physiological properties. Dr. Gee found that the latter produced the same emetic action as apomorphine from morphine; whilst the experiments of Dr. J. G. Blackley prove that the former base is destitute of emetic action on cats, only producing profuse salivation when subcutaneously injected in doses up to 0·1 grm.

It hence appears that the removal of the elements of water from (hypothetical) dimorphine, and from tetramorphine respectively, gives rise to an alteration in the physiological properties of the derivatives, the emetic action on cats being the *more* marked in the first case the more H_2O is removed, the *less* so in the second case. Thus the following table exhibits the change in physiological action :—

Name of Base.	Relation to Morphine.	Physiological Action.	Observer.
		Di Series.	
Dimorphine.	$\overline{M}_2$.	(?)	—
Diapodimorphine.	$\overline{M}_2-2H_2O$.	Produces profuse salivation, but no vomiting (cats).	Dr. J. G. Blackley.
Tetrapodimorphine.	$\overline{M}_2-4H_2O$.	Moderately powerful emetic (cats). Very powerful emetic (man).	Drs. Gee and Stocker.
		Tetra Series.	
Tetramorphine.	$\overline{M}_4$.	Very powerful emetic (cats).	Dr. Stocker.
Diapotetramorphine.	$\overline{M}_4-2H_2O$.	Do. do. (cats and dogs).	Do.
Tetrapotetramorphine.	$\overline{M}_4-4H_2O$.	Produces profuse salivation, but no vomiting (cats).	Dr. J. G. Blackley.
Octapotetramorphine.	$\overline{M}_4-8H_2O$.	Neither salivation nor vomiting produced (cats).	Do.

Action of Hydrobromic Acid on Codeine.

The results just detailed render it probable that the formation of "bromocodide" is preceded by that of a less brominated base probably $(\overline{C}+HBr),2HBr$, which appears, in fact, to be the case.

On heating codeine to 100° for three hours with 5 to 6 parts of 48 per cent hydrobromic acid, precipitating with sodium carbonate, solution of precipitate in ether, and agitation of ethereal solution with hydrobromic acid, a viscid non-crystalline hydrobromide is obtained, much resembling bromocodide hydrobromide, but containing less bromine.

After drying at 100°, the gum-like mass gave these numbers—

0·3410 grm. gave 0·6310 CO_2 and 0·158 H_2O.
0·3000 „ „ 0·2205 AgBr.

These numbers agree with the composition—

$$2(\overline{C}+HBr),2HBr+\underbrace{(\overline{C}+2HBr-2H_2O)}_{\text{Bromocodide.}},2HBr.$$

	Calculated.	Found.
Carbon ..	50·47	50·47
Hydrogen ..	5·14	5·15
Bromine ..	31·15	31·27

Whence it appears that the first action of hydrobromic acid on codeine is perfectly parallel with that of hydrochloric acid; it has already been shown, however (*Proc. Roy. Soc.*, xix., 371, 504), that the further action of hydrobromic acid gives rise to products not identical with those formed by means of hydrochloric acid whether acting at 100° or at higher temperatures.

From its physical properties, it appears probable that the "deoxycodeine" thus formed belongs to the dicodeine series, *i.e.*, its formula contains C_{72}; whilst the "bromotetracodeine" simultaneously produced is a tetra base, *i.e.*, its formula contains C_{144}: the formation of these two bases may, then, be explained by the following equation :—

$$8(\overline{C}+HBr)2HBr+\underbrace{2(\overline{C}+2HBr-2H_2O)}_{\text{Bromocodide.}},2HBr=8HBr+$$

$$+\underbrace{(\overline{C}_2+H_8-4H_2O)}_{\text{Deoxycodeine.}},4HBr+\underbrace{2(\overline{C}_4-H_4+2HBr)}_{\text{Bromotetracodeine.}},8HBr.$$

This reaction is different from that formerly given (*loc. cit.*), where the action was supposed to consist, at any rate partly, in the replacement of bromine by hydroxyl; it now appears more probable that this replacement does not take place, the hydroxyl group being subtracted from a portion of the formula different from that to which the bromine symbol is added.

The table on next page represents the relation to codeine and morphine of the derivatives obtained up to this time from codeine;* inasmuch as the "apomorphine" obtained from codeine by the action of hydrochloric acid at 140° to 150° appears to be identical with that derived from morphine under the same or other conditions, whilst the bases obtained by the action of hydriodic acid and phosphorus from codeine and morphine appear to be identical also, the conclusion may be drawn that codeine is actually dimethylated morphine, *i.e.*, $\overline{C}=\overline{M}+2CH_3-H_2$.

All these derivatives may be regarded as formed by the addition of the elements of *m* proportions of hydriodic, hydrochloric, or hydrobromic acid to, and the subtraction of *n* proportions of water from, a polymeride either of codeine or of morphine, or a base derived from one or other of these by the addition or subtraction of hydrogen; in short, all of these derivatives (together with those obtained from morphine as starting-point, and tabulated in a previous paper [*Journ. Chem. Soc.*, II., xi., 211]) may be included in one or other of the two formulæ—

$$(\overline{C}\pm H_p)x+mHX-nH_2O$$
$$(\overline{M}\pm H_p)x+mHX-nH_2O$$

* *Proc. Roy. Soc.*, xvii., 460; xviii., 83.

* Matthiessen and Wright, *Proc. Roy. Soc.*, xvii., 460; xviii., 83. Wright, *ibid.*, xix., 371, 504; xx., 8, 278.

DERIVATIVES CONTAINING $x C_{36}$ (CODEINE SERIES).

Mono Series.

Name.	Formula.	Origin.	Relation to Codeine.
Codeine.	$C_{36}H_{42}N_2O_6$.	—	$\overline{C}$.
—	$C_{36}H_{43}ClN_2O_6$.	Codeine and HCl.	$\overline{C}+HCl$.
Chlorocodide.	$C_{36}H_{40}Cl_2N_2O_4$.	Do. do.	$\overline{C}+2HCl-2H_2O$.
—	$C_{36}H_{43}BrN_2O_6$.	Do. and HBr.	$\overline{C}+HBr$.
Bromocodide.	$C_{36}H_{40}Br_2N_2O_4$.	Do. do.	$\overline{C}+2HBr-2H_2O$.

Di Series.

Dicodeine.	$C_{72}H_{84}N_4O_{12}$.	Codeine and H_3PO_4. Do. and H_2SO_4.	$\overline{C}_2$.
—	$C_{72}H_{83}ClN_4O_{11}$.	Dicodeine and HCl.	$\overline{C}_2+HCl-H_2O$.

Tri Series.

Tricodeine.	$C_{108}H_{126}N_6O_{18}$.	Codeine and H_2SO_4.	$\overline{C}_3$.
—	$C_{108}H_{114}N_6O_{12}$.	Tricodeine and HCl.	$\overline{C}_3-6H_2O$.

Tetra Series.

Tetracodeine.	$C_{144}H_{168}N_8O_{24}$.	Codeine and H_3PO_4. Do. and H_2SO_4. Dicodeine and H_2SO_4.	$\overline{C}_4$.

DERIVATIVES FROM BASES MORE HYDROGENISED THAN CODEINE.

$(\overline{C}+H_4)_2$ *Series.*

Deoxycodeine.	$C_{72}H_{84}N_4O_8$.	Codeine and HBr.	$(\overline{C}+H_4)_2-4H_2O$.

DERIVATIVES FROM BASES LESS HYDROGENISED THAN CODEINE.

$(\overline{C}-H)_4$ *Series.*

Bromotetracodeine.	$C_{144}H_{166}Br_2N_8O_{24}$.	Codeine and HBr.	$(\overline{C}-H)_4+2HBr$.
Chlorotetracodeine.	$C_{144}H_{166}Cl_2N_8O_{24}$.	Bromotetracodeine and HCl.	$(\overline{C}-H)_4+2HCl$.

DERIVATIVES CONTAINING $x C_{34}$ (MORPHINE SERIES OF BASES DERIVED FROM CODEINE AS STARTING-POINT.)

Di Series.

Apomorphine. (Tetrapodimorphine).	$C_{68}H_{68}N_4O_8$.	Codeine and HCl at 150°. Chlorocodide and do.	$\overline{M}_2-4H_2O$.
Diapodimorphine.	$C_{68}H_{72}N_4O_{10}$.	Codeine and HCl at 100°.	$\overline{M}2-H_2O$.

Tetra Series.

Tetrapotetramorphine.	$C_{136}H_{144}N_8O_{20}$.	Codeine and HCl at 100°.	$\overline{M}_4-4H_2O$.

DERIVATIVES FROM BASES MORE HYDROGENISED THAN MORPHINE.

$(M+H_4)_2$ *Series.*

Deoxymorphine.	$C_{68}H_{76}N_4O_8$.	Codeine and HBr. Bromocodide and HBr.	$(\overline{M}+H_4)_2-4H_2O$.

$(\overline{M}+H_2)_4$ *Series.*

—	$C_{136}H_{153}IN_8O_{20}$.	Dicodeine, HI, and P.	$(\overline{M}+H_2)_4+HI-4H_2O$.

$(\overline{M}+H_4)_4$ *Series.*

—	$C_{136}H_{172}I_4N_8O_{24}$.	Codeine, HI, and P at 100°.	$(\overline{M}+H_4)_4+4HI$.
—	$C_{136}H_{164}I_4N_8O_{20}$.	Do. do. at 115°.	$(\overline{M}+H_4)_4+4HI-4H_2O$.
—	$C_{136}H_{162}I_2N_8O_{20}$.	Preceding, treated with water.	$(\overline{M}+H_4)_4+2HI-4H_2O$.
—	$C_{136}H_{161}IN_8O_{20}$.	Do. do.	$(\overline{M}+H_4)_4+HI-4H_2O$.
—	$C_{136}H_{160}N_8O_{20}$.	Do. do.	$(\overline{M}+H_4)_4-4H_2O$.

$(M+H_8)_4$ *Series.*

—	$C_{136}H_{161}I_4N_1O_{12}$.	Codeine, HI, and P at 135°.	$(\overline{M}+H_8)_4+4HI-12H_2O$.
—	$C_{136}H_{170}N_8O_{20}$.	Preceding and water.	$(\overline{M}+H_8)_4-4H_2O$.
—	$C_{136}H_{178}I_2N_8O_{20}$.	Do. and HI.	$(\overline{M}+H_8)_4+2HI-4H_2O$.

DERIVATIVES FROM BASES LESS HYDROGENISED THAN MORPHINE.

$(\overline{M}-H)_4$ *Series.*

Bromotetramorphine.	$C_{136}H_{150}Br_2N_8O_{24}$.	Codeine and HBr. Bromocodide and HBr.	$(\overline{M}-H)_4+2HBr$.
Chlorotetramorphine.	$C_{136}H_{150}Cl_2N_8O_{24}$.	Bromotetramorphine and HCl.	$(\overline{M}-H)_4+2HCl$.

Where p varies from 0 to 8,
$x = 1, 2, 3$, or 4 (giving rise to the mono, di, tri, and tetra series respectively ;
m varies from 0 to 4 ;
X is either Br, I, or Cl ;
n varies from 0 to 12.

In many instances the bases thus produced from codeine and morphine (some forty in number) have not been named, the complexity of their composition, and the scanty knowledge as yet possessed of their relations to other substances precluding the possibility of a systematic nomenclature; where names have been given from motives of convenience in reference, the chief point aimed at was to indicate the nature of the relation of the derivative to the parent base; thus, the name "diapotetramorphine" indicates that the formula of the base is obtained from that of the "tetra" polymeride of morphine by the subtraction of the elements of two proportions of water, *i.e.*, that the composition is indicated by the expression—

$$\overline{M}_4 - 2H_2O.$$

Objections may be raised to the use of the prefix "apo," to indicate the removal of the elements of water, on the ground that there is no reference to *water* in the etymology of the term; but the prefix "anhydro" is open to the more serious objection that it really indicates the contrary of the prefix "hydro," which refers to the addition, *not of the elements of water, but of hydrogen* (hydroquinone, hydrocyanic acid, hydrocinnamic acid, &c., &c.); whilst the prefix "meta," which has been used in the sense in which "apo" has been employed during these researches (Barker, *Am. Journ. Sci.*, vol. xliv., Nov., 1867), is also used to indicate a particular class of benzene derivatives, which are in no way producible from the parent body by the removal of the elements of water. The inconvenience and ambiguity occasioned by the inconsistent meanings thus attachable to the terms "anhydro" and "meta" are such as to warrant the invention of a new term when precision in language is desired.

Each one of the bases mentioned in the following table form a hydrochloride (hydrobromide or hydriodide) containing as many proportions of hydrochloric (hydrobromic or hydriodic) acid as there are nitrogen symbols in the formula.

Three other compounds, not included in the foregoing tables, have also been obtained, viz.:—

Chloro-dicodeine-dimorphine-hydrochloride—

$$C_{140}H_{158}Cl_2N_8O_{24},8HCl,$$

which is homologous with, and intermediate between, chloro-tetracodeine and chloro-tetramorphine hydrochlorides. Also the compounds $C_{136}H_{214}I_6N_8O_{44},8HI$ and $C_{136}H_{206}I_6N_8O_{32},8HI$, obtained by the action of hydriodic acid on the compounds $(\overline{M}+H_4)_4-4H_2O$ and $(\overline{M}+H_4)_4+4HI$, respectively.

These two latter derivatives may be represented by the formulæ—

$$(\overline{M}+H_4)_4+6HI+20H_2O$$

and— $$(\overline{M}+H_8)_4+6HI+8H_2O,$$

differing from all the other derivatives of $(\overline{M}+H_4)_4$ and $(\overline{M}+H_8)_4$ in that the elements of water are added on, instead of being subtracted, while the elements of six proportions of hydriodic acid are also added on, four being the highest number in the other cases.

Royal Society.—At a meeting held last night the following gentlemen were elected Fellows of the Royal Society:—William Aitken, M.D.; Sir Alexander Armstrong, M.D.; Robert Stawell Ball, LL.D.; John Beddoe, B.A., M.D.; Frederic Joseph Bramwell, C.E.; Staff-Captain Edward Kilwick Calver, R.N.; Robert Lewis John Ellery; Lieut.-Colonel James Augustus Grant, C.B., C.S.I.; Clements Robert Markham, C.B.; George Edward Paget, M.D., D.C.L., LL.D.; George West Royston Pigott, M.A., M.D.; Osbert Salvin; Hon. John William Strutt; Henry Woodward; James Young.

AFFINITY OF HYDROGEN TO THE METALLOIDS.

In *Poggendorff's Annalen* (Nos. 2 and 3, 1873), Julius Thomsen, of Copenhagen, gives an account of somewhat elaborate researches on the affinity of hydrogen to the metalloids chlorine, bromine, iodine, oxygen, sulphur, nitrogen, and carbon.

The affinity of chlorine to hydrogen he determined directly; those of bromine and iodine through decomposition of aqueous solutions of bromide of potassium and iodide of potassium by means of chlorine. It was necessary here to determine the absorption-heat of hydrochloric, hydrobromic, and hydriodic acids.

The affinity of hydrogen to oxygen, in water, was determined by direct burning of oxygen in hydrogen; that of hydrogen to sulphur through the reaction of sulphuretted hydrogen with iodine. The absorption-heat of sulphuretted hydrogen he had previously ascertained.

Next, the affinity of hydrogen to nitrogen, in ammonia, was determined through decomposition of solution of ammonia by means of chlorine, the absorption-heat of ammonia being at the same time also determined.

As regards hydrogen and carbon, previous observers were pretty much at one in the case of marsh-gas and æthylene, and Herr Thomsen gave special attention to acetylene, about which no researches have been published. He determined, however, the heat of combustion of æthylene, from which the heat of combination can be deduced.

We do not here stay to describe the apparatus Herr Thomsen constructed for his experiments, but limit ourselves to a statement of the chief numerical results, and the deductions made from them.

And, first of all, the following table gives the affinities in the various cases specified:—

		c.	
HCl	=	22001	
HBr	=	8440	
HI	=	−6036	
H_2O	=	68357	
H_2S	=	4512	
H_3N	=	26707	
H_4C	=	20420	Where C denotes graphite.
H_4C_2	=	−10880	
H_2C_2	=	−55010	
H_4C'	=	23780	Where C' denotes charcoal.
$H_4C'_2$	=	−4160	
$H_2C'_2$	=	−48290	

From this it appears that the affinity of hydrogen to chlorine, bromine, and iodine, decreases in a marked way with the increasing atomic weight of these substances. In the case of chlorine it is strongly positive; less for bromine; and negative for iodine. This seems to be a general relation; for in the next natural group of the metalloids also—oxygen, sulphur, selenium, and tellurium—we have, for the first two members, 68357 c. and 4512 c.; and, from M. Hautefeuille's researches, it appears that the affinity in seleniuretted hydrogen is negative, showing a close correspondence in these three with the first three—chlorine, bromine, and iodine.

In the third natural group—nitrogen, phosphorus, arsenic, antimony, and bismuth—the affinity of hydrogen to the first, nitrogen, is positive, viz., in ammonia, 26707 c. That, in the others, the affinity decreases with the increasing atomic weight, appears from the properties of their several hydrogen combinations; they are all easily decomposed by heat, arseniuretted hydrogen more easily than phosphuretted hydrogen, and still more easily antimonietted hydrogen (decomposed even at ordinary temperature); while there is no known combination between bismuth and hydrogen, probably on account of high decomposability. Doubtless, therefore, in this group also, the same thing holds good.

In the carbon group, the affinity in the case of the first member, CH_4, is 20420 c., or strongly positive; that it is considerably less in the next, silicium, may be inferred from the behaviour of siliciuretted hydrogen; while, with the higher members, tin and platinum, no such compounds occur. Thus, in all the four groups, the law may be said to hold.

Examining a little more closely the halogen group, we do not perceive, between the first three numbers in the above column a simple relation. The difference between the first and second is 13561 c., while that between the second and third is 14476 c. (not very far apart from the other). But the three numbers are not directly comparable with each other, because chlorine, bromine, and iodine are not found in the same aggregate state. To estimate the affinity for all the three substances in the gaseous state, we should add to the last two numbers the latent heat of transformation into gas. Doing so, we have the numbers 22001 c., 120090 c., −2986 c., the differences becoming 9911 c. and 15076 c. These numbers are more irregular than the former, so that bromine does not now stand about midway between chlorine and iodine. Indeed—

$$9911 = 2 \times 4956 \text{ c.}$$
$$15076 = 3 \times 5025 \text{ c.}$$

which factors might, perhaps, be taken as identical, on account of uncertainty in determination of the latent heat of iodine, but it is difficult to say whether this relation is more than an accident.

It appears, then, from these (and other) comparisons, that bromine, with reference to the affinity for hydrogen, stands very much nearer to chlorine than its atomic weight (almost midway between those of chlorine and iodine) might lead us to expect.

Consider, next, the numbers in the above table expressing the affinity between carbon and hydrogen. If we take the first group, in which carbon is in the form of graphite, we have—

$$C_2H_2 = -55010$$
$$C_2H_4 = -10880$$
$$CH_4 = +20420$$

From this it appears that the formation of the first of these hydrocarbons is accompanied with a marked absorption of heat. We might be inclined to say that the affinity of carbon for hydrogen was *negative*; it is found, however, that hydrogen, in uniting with the already-formed lower hydrocarbons, causes a considerable development of heat. Thus—

$$C_2H_2 = -55010 \text{ c.}$$
$$C_2H_4 - C_2H_2 = C_2H_2,H_2 = +44130 \text{ c.}$$
$$2CH_4 - C_2H_4 = C_2H_4,H_4 = +51720 \text{ c.}$$

And there can be no doubt that the affinity between carbon and hydrogen is, in fact, *positive*, as appears, also, from the determination $CH_4 = +20420$ c. How is this peculiar relation of carbon to hydrogen to be explained? And what is the cause of the remarkable phenomenon, that carbon appears inactive towards hydrogen, even at a high temperature, so that, only at the highest known temperature, under the influence of the electric spark, does it unite with hydrogen, with absorption of a considerable quantity of heat; that, once united with hydrogen, however, in the form of acetylene, the affinity to hydrogen appears unsatisfied, so that further quantities of hydrogen readily unite with acetylene, and that with development of heat?

If we consider the general behaviour of carbon we shall find that that has its type in this phenomenon. Carbon combines with no element at ordinary temperature; it always needs a high temperature for such combination, where possible. Thus, oxygen and sulphur combine directly with hydrogen only at a high temperature. With the remaining metalloids no direct combinations are obtainable, even at very high temperatures (with exception of hydrogen, now considered). Once combined with these other substances, however, the carbon readily enters into other combinations. Thus, *e.g.*, carbonic oxide readily combines with oxygen into oxalic acid and carbonic acid; with chlorine, into oxychloride of carbon; with hydrate of sodium, into formic acid, &c.

In agreement with this behaviour is the fact that the formation of carbon combination, is always, with one exception, accompanied by absorption of heat. Examples are—the formation of sulphuret of carbon, of cyanogen or carburetted nitrogen, of acetylene or carburetted hydrogen. The only exception is oxygen, in the combination of which with carbon heat is developed, even when the lowest oxidation product, carbonic oxide, is formed. On further comparison of these heat phenomena, however, the behaviour towards oxygen will be found only an apparent exception. We have—

$$CO = 26800 \text{ c.}$$
$$CO,O = 66800 \text{ c.}$$

Thus, while the first atom of oxygen which combines with carbon only develops 26800 c., the heat development of the second oxygen atom, which changes the carbonic oxide into carbonic acid, is about two and a half times as great. From all that has been learned as to the oxidation of other substances, we must suppose that the first oxygen atom gives the greatest, and the following give a smaller, heat development; whereas, here the reverse occurs, and we may therefore infer that, were the affinity of carbon to hydrogen generally not so great as it is, the first oxidation product here also would appear with a seemingly negative affinity.

The entire behaviour of carbon may be explained if we consider that, whether in the form of charcoal, graphite, or diamond, it is in an inactive or passive condition, out of which it must be brought before it can enter into combination with other elements, and that an expenditure of force is required for this. The data hardly permit of determining accurately the force which is necessary; it appears, however, to be about 70000 c. for each atom of carbon.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 5, 1873.

Dr. ODLING, F.R.S., President, in the Chair.

THE list of visitors having been announced, and the minutes of the previous meeting read and confirmed, Mr. W. H. Greenwood was formally admitted a Fellow of the Society. The following names were then read for the first time:—Messrs. Edward Collins, William Charles Young, George Bult Francis, John Turner, and William Edward Porter.

The first paper read was entitled "*The Dioxides of Calcium and Strontium*," by Sir J. CONROY, Bart., M.A. After alluding to the circumstance that, although the existence of the peroxides of calcium and strontium had been announced by Thenard in 1817, no account of them had been published since then, the author stated that lime and strontia, unlike baryta, do not absorb oxygen at a high temperature. When, however, an aqueous solution of sodium peroxide is added to a solution of a strontium salt, a hydrated peroxide of strontium is precipitated in crystalline scales, having the composition $SrO_2,8H_2O$. The author has also obtained hydrates containing 10 and 12 molecules of water respectively. All these hydrates lose their water at 100°, leaving strontium peroxide, SrO_2, in the form of a white powder. The hydrated calcium peroxide, $CaO_2,8H_2O$, prepared by adding excess of lime-water to a solution of sodium peroxide acidulated with

nitric acid, is similar in appearance to the corresponding strontium compound, and, like it, loses its water at 100°, leaving the anhydrous calcium peroxide as a pale buff-coloured powder.

The President said the thanks of the Society were due to the author for having so satisfactorily established the existence of these dioxides. The action of an acidulated solution of sodium peroxide appeared to offer a facile method for their preparation.

Mr. T. Wills then described a new ozone generator, which he stated was a modification of one in general use. Siemens's tube had the disadvantages of being difficult to construct and very liable to be broken; moreover, it became heated after being used for some time. This last objection also applied to Bean's apparatus of glass plates covered with tin-foil. Sir Benjamin Brodie, in his experiments, had employed an apparatus similar in principle to the Siemens tube, but the tin-foil surfaces were replaced by water; this worked very efficiently, but it was not easy to adapt to other pieces of apparatus. The new generator consists of a piece of glass tube as cylindrical as possible, with an annular coating of tin-foil on the exterior; in the interior is a carefully-turned brass box, slightly smaller than the glass tube, and tinned to protect it from the action of the ozone. Through this box a current of ice-cold water can be passed, so as to prevent the heating of the apparatus, the oxygen or air passing through the annular space between the box and the glass tube, which is fitted with caps and tubes for that purpose. The brass box and tin-foil coating are connected with the induction coil in the usual way. This apparatus yields large quantities of ozone with great ease, and, with the same battery power, appears to be more powerful than either of the other forms of apparatus; its cost, moreover, is small, and it is not liable to be broken. It can also easily be adapted to other pieces of apparatus, and the current of cold water keeps the apparatus cool, thus allowing it to be used for any length of time.

The President said he had worked with the apparatus, and could fully confirm what the speaker had said. He also drew attention to the great convenience of employing paraffin joints when working with ozone, as pointed out by Sir Benjamin Brodie, since that hydrocarbon is not attacked by it.

Mr. Bean asked whether the author had compared the new form of apparatus with his, using the same surface, as he had found that with the same battery power a small surface gave more ozone than a large one.

Mr. Tisley, in reply to a question of Mr. Bean as to the difficulty of obtaining large glass tubes, said that, for a large ozone apparatus, it would probably be better to use a number of comparatively small tubes worked in cascade.

Mr. W. N. Hartley then read a paper "*On the Behaviour of Acetamide when Heated with Sodium Alcohol.*" The author heated sodium methylate with acetamide in hopes of obtaining methylamine, but the reaction took a different course; ammonia was evolved, but no compound ammonia was produced. On repeating the experiment with sodium ethylate, no ethylamine was obtained, but ammonia was given off, and a crystalline substance resembling cholesterine formed in the solution. This, however, when examined microscopically, was found to consist merely of feathery crystals of acetamide enclosed in plates of sodium ethylate. Acetamide and sodium ethylate, even when mixed dry and heated to redness, do not yield any compound ammonia.

The President having thanked the author for the care and perseverance with which he had conducted his experiments,

Dr. Armstrong said he could confirm Mr. Hartley's results, as a few years ago he had himself endeavoured to prepare ethylamine from sodic ethylate and acetamide, and had obtained nothing but ammonia.

The Secretary then read a paper "*On Iodine Monochloride*," by J. B. Hannay. In preparing this substance the author employed the usual processes, namely, passing chlorine into iodine until it becomes liquid and then rectifying the product, also by heating a mixture of iodine and potassic chlorate, and rectifying the product over potassic chlorate. He notices many curious circumstances connected with the crystallisation of this substance, which possesses a deep red colour in a liquid state, and when crystallised is "of a brilliant plumbago or iodine lustre." It melts at 24·7°, boils at 100·5° to 101·5°, and has a density of 3·263 at 0°. Its vapour density at 120° was found to be 80·27; theory, 81·2. Iodine chloride is decomposed by water, iodine being precipitated, and iodic acid and hydrochloric acid formed; the latter dissolves a small portion of iodine monochloride and prevents its decomposition. The compound was analysed, and its behaviour observed with numerous substances both elementary and compouud. The author did not succeed in obtaining the iodine tetrachloride described by Kämmerer, although he made numerous experiments with that object.

Dr. Odling said the Society was much indebted to the author for his careful investigation of this substance, which was the more interesting as it was the only known example of an electro-negative monochloride.

The next communication, "*On Triferrous Phosphide*," by R. Schenck, was read by the author, who prepared this substance by pouring a solution of ferrous sulphate into a flask in which phosphoretted hydrogen was being evolved by the action of potassic hydrate on phosphorus. The precipitate of ferrous hydrate at first formed, rapidly becomes grey, and finally black. After removal of the phosphorus, the iron phosphide was purified by boiling it with a solution of potassic hydrate, and subsequently with hydrochloric acid. The results of the analyses corresponded to the formula Fe_3P_2; the phosphorus appearing to be trivalent. The ferrous phosphide dissolves slowly in boiling acids, with evolution of gas, and in the dry state takes fire below 100°, burning to a reddish-brown powder. The author intends to apply the same method to the preparation of other phosphides.

The President having thanked the author in the name of the Society, a paper "*On Sulphur Bromide*," by J. B. Hannay, was read by the Secretary. On adding bromine to sulphur in the proportions to form SBr, heat is developed, and a deep red liquid formed, of density 2·629, which cannot, however, be distilled without decomposition. On exposure to the air it absorbs moisture, and crystals of sulphur are deposited which are soluble in carbon disulphide. It dissolves phosphorus with evolution of heat, but on attempting to distil the solution it explodes; this would seem to be owing to the sulphur bromide acting merely as a solvent for the phosphorus until heat is applied, when a decomposition suddenly takes place. With iodine chloride, sulphur bromide yields sulphur chloride and bromide of iodine. Its behaviour with methylated spirit, potassium, sodium, aluminium, and arsenic are also described.

The President, after returning thanks to the author for his communication, adjourned the meeting until Thursday, June 19, when the following papers will be read:—1. "On the Influence of Pressure upon Fermentation, part II., by Horace Brown; 2. "Researches on the Action of the Copper Zinc Couple on Organic Bodies, III.," and "On Normal and Isopropyl Iodides." by Dr. J. H. Gladstone and A. Tribe; 3. "On Cymenes from Different Sources Optically Considered," by Dr. J. H. Gladstone; 4. "On the Action of Bromine on Alizarine," by W. H. Perkin; 5. "On some Decompositions and Oxidation Products of Morphine and Codeine Derivatives," by E. L. Mayor and Dr. C. R. A. Wright; 6. "On the Decomposition of Tricalcic Phosphate by Water," by R. Warington; 7. "On a New Tellurium Mineral, with Notes on a Systematic Mineralogical Nomenclature," by J. B. Hannay; 8. "Communications from the Laboratory of the London Institution, No. XII.; On New Derivatives of Cresol," by H. E. Armstrong and C. L. Field.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, May 12, 1873.

Tumefaction of Obsidian when Exposed to an Elevated Temperature.—MM. Boussingault and Damor.—Obsidian exposed to the action of fire suffers no change at a cherry-red heat, but between an orange-red and a red-white it swells up suddenly to a colourless spongy mass, not unlike pumice. At higher temperatures it resumes its vitreous state. The authors, in studying this phenomenon, find that the loss of weight per gramme in no case exceeded 0·00730 grm.; that the increase of bulk was from 200 to 700 per cent; that the emission of gases was slight, and in many cases absolutely *nil*; that the loss of weight was due chiefly to the escape of water and hydrochloric acid.

New Researches on Aldol.—A. Wurtz.—The author remarks that his view on the double nature of aldol as at once an aldehyde and an alcohol have been confirmed. Aldol after distillation, even when refrigerated, re-heats spontaneously; the temperature, in a receiver surrounded with ice, having been found to rise from 11° to 54° in seventy minutes. On cooling it becomes viscid. It possesses the reducing power common to the aldehydes. The author regards it as the aldehyde of β-oxybutyric acid. The paper concludes with a protest against the criticism of Kolbe.

Isomeric and Allotropic Transformations.—Troost and Hautefeuille.—The authors bring forward a body of novel facts which establish an intimate connection between the physical phenomena of evaporation and the chemical phenomena of isomerism and allotropy. Striking analogies have been already established between the respective phenomena of condensation (of vapours) and of combination, and again between those of evaporation and of decomposition. Carbonate of lime in decomposition obeys the same laws as the evaporation of water. Since 1868 the authors have been studying the law of the phenomena of a change of state, when such change corresponds to a change of chemical or physical properties without an alteration of composition. They have assimilated these phenomena to those of dissociation, and have applied the same procedure for their measurement. They have observed a "tension of transformation." They show, as regards the decomposition of the cyanides of silver and mercury, that the proportion of paracyanogen in the residue increases with the pressure exercised by the cyanogen liberated; the transformation is limited by the tension of the gas, which depends on the temperature. This fact has led them to discover the inverse transformation of paracyanogen into cyanogen gas, which begins about 360°, and is slow even at 500°. They show also that cyamelide and cyanuric acid under the influence of heat behave like paracyanogen. Reciprocally cyanic acid in vapour is transformed into cyanuric acid, and the tensions which limit this novel phenomenon are numerically equal to those obtained in the inverse transformation. They also study the phenomena of tension, and the calorific phenomena which attend the transformation of white phosphorus into its red state. They establish a sharply-marked distinction between the tension of vapour in a limited space, and the tension of transformation of the same body. This distinction permits us to analyse thoroughly the allotropic transformation of phosphorus. They show that the conversion of ordinary phosphorus into its liquid and its red state is quite comparable to the transformation of liquid cyanic acid into cyamelide. They show that the vapour of phosphorus acquires first its maximum tension corresponding to the temperature employed. This tension gradually lessens during the formation of red phosphorus, and attains a constant value—the *tension of transformation* at the same temperature. Phosphorus boils under ordinary atmospheric pressure at 290°. At 360° and 440° the tension becomes respectively 3·2 and 7·5 atmospheres. At 577° it had risen to 56 atmospheres.

New Process for the Proximate Analysis of Rocks.—M. Fouqué.—1 to 2 kilos. are reduced to a coarse powder (¼ millimetre in diameter): the powder is divided into two portions, the one for mechanical, and the other for chemical examination. The former is submitted to a powerful electro-magnet set in action by 6 to 8 Bunsen elements. All the ferruginous parts are thus removed. The chemical treatment consists in the use of concentrated hydrofluoric acid for a short time. This process has been applied successfully in an examination of the lavas of Santorino.

Action of Sulphur on Arsenic.—A. Gélis.—The author has obtained the sulphides of arsenic by direct action. On heating sulphur with an excess of metal there is formed a single product, the bisulphide S_2As. It is red, opaque, and crystalline, and is distinct from the "false realgar" of commerce. With an excess of sulphur we obtain the pentasulphide S_5As. If 1 part arsenic is heated in a flask with 7 to 8 parts of sulphur the metal disappears, forming a transparent liquid, which when cooled takes the consistence of india-rubber; in time it becomes brittle. Ammonia separates it into pentasulphide, which dissolves, and free sulphur. On distillation we obtain first sulphur, then sulphur containing arsenic. The pentasulphide remains, but it is not stable, for at higher temperatures it is resolved into sulphur, and a trisulphide S_3As. The sulphide of carbon acting upon the arsenical sulphur presents curious phenomena. It abandons at first all the common sulphur which it contains, and the liquid becomes coloured. At each new treatment it removes a little sulphur without becoming saturated. Artificial realgar and orpiment are mixtures of the various sulphides of arsenic.

Action of Hydrochloric Acid Gas upon the Compound Ammonias.—Ch. Lauth.—Reserved for full insertion.

Action of the Oxygen Dissolved in Water upon Reducing Agents.—P. Schützenberger and Ch. Risler.—Hyposulphite of soda and ammoniacal cuprous oxide when in contact, in the cold and in excess, with oxygen dissolved in water, cause the latter to be divided into two portions; one of which oxidises the reducing agent, whilst the other remains in the liquid. Stannate of soda removes the whole of the dissolved oxygen. The authors believe that the oxygen remaining in the water enters into combination therewith. Thus, aërated water strongly coloured with carmine of indigo was exactly decolourised with hyposulphite. It resumed a blue colour on heating to 40°. The colour reappeared also in the cold, though more slowly. If we decolourise a second time the same phenomenon is reproduced until hyposulphite has been added enough to decolourise in the cold the same volume of aërated water. A dilute solution of oxygenated water produces the same effects.

Portative Force of Magnets.—M. J. Jamin.—The author exhibited two magnets made on his system; one weighing 6 kilogrms. and carrying 80; the other (thought to be the most powerful ever made) carries about 500 kilogrms., having a weight ten times less. He explains the principles on which the best possible magnet may be

constructed from plates of a given steel and length. They are briefly these:—(1) The contact should conceal the entire magnetism expanded over the exterior surface of the magnet; for this a sufficient mass should be given it. (2). This mass given the surface of adherence should be reduced till one perceives an increase in the small amount of free magnetism which the application of the contact leaves on the magnet. (3). The length and breadth of the plates being determined, their number should be sufficient to cause a little free magnetism to appear on the magnet when the contact is applied. If their number is less, the limit of permanent force is not reached; if greater, nothing more is gained. (4). The armatures should be strong and well applied; their weight should not, however, be exaggerated. M. Jamin shows how on these principles he constructed the magnets in question.

The Seine; Hydrological Studies.—M. Belgrand.

Electro-Diapason with Continuous Motion.—M. Mercadier.—The author wished to construct an apparatus capable—(1) of dividing time into very small equal fractions; (2) of doing so continuously; (3) of conveniently registering these fractions. The instrument he made is as follows:—A tuning-fork is placed upright, and a small electro-magnet is fixed on a support opposite the face of one of its branches; which, on the other side, has fixed to it an "interruptor style" of platinum wire. The other branch has also a style which registers its movement on a rotating blackened cylinder. Between the branches is a platinum plate on a separate support; and with this plate the interruptor style comes into contact when the branches approach each other. The positive rheophore of a pile is connected with the plate; the negative with the electro-magnet. If now the plate is put in contact with the interruptor style a spark appears, the current passes, the diapason begins to vibrate, and the interruptor style synchronously with it. The distance of the plate is varied till the maximum amplitude of vibration is obtained. This instrument is said to work very satisfactorily.

Observations Relative to the Notes of M. du Moncel and of MM. Thenard on the Decomposition of Carbonic Acid by the Electric Effluve.—M. J. G. Jean.

Observations Relative to a Communication of M. du Moncel on the Condensed Effluve of the Induction Discharge.—M. Houzeau.—The writer calls attention to his simple-action and double-action *ozonisers*, omitted rom M. du Moncel's description of apparatus for experiments of this kind.

Modification of the Optical Saccharimeter.—M. Prazmowski.—Soleil's instrument requires considerable perfection in the visual organ to appreciate exactly the uniformity of colourlng in the two halos of the field; and, in view of this, some have sought to improve on it by making the observation depend on perceiving a slight difference between two luminous intensities. M. Frellet and M. Cornu have suggested means of effecting this. M. Prazmowski's method is to use a bi-plate of spar (in place of Soleil's plate with two rotations), the face of separation being placed in the principal section of the rism. He utilises Soleil's compensator.

Spring Frosts and Winter Frosts.—M. Martha Beker.

May 19, 1873.

New Observations concerning the Influence of Metallic Deposits upon Zinc in presence of Acids and Bases—New Processes of Heliography.—M. C. Gourdon.—Zinc, coated with certain metals, becomes exceedingly liable to be attacked by reagents. Thus, if a sheet of this metal is coated in part with a thin layer of pulverulent platinum, it is capable of being attacked by sulphuric acid diluted with 7000 vols. of water. If the platinum is replaced by gold, the zinc can be dissolved by sulphuric acid diluted with 5000 times its volume of water. Copper causes action up to 4000 volumes, silver to 3500, tin to 1500, antimony to 700, bismuth to 500; mercury does not react similarly. If placed upon the zinc in the form of a salt it produces a spot which gradually extends itself. The solution of the zinc is most active on the margin of the spot. The soluble arsenites, arseniates, and antimoniates give spots variable in appearance. They promote the solution of the zinc, but more feebly. Cobalt, nickel, and iron resemble platinum in the intensity of action they occasion when deposited upon zinc. Cobalt renders zinc soluble in sulphuric acid diluted with 10,000 volumes of water. Salts of the same base, with different acids, do not behave identically. Chlorides yield more energetic deposits than sulphates, and these, again, than nitrates. Salts rendered alkaline by the addition of a trace of ammonia give more energetic deposits than the same salts used alone. Some salts which produce no deposit when used alone give very energetic ones when previously treated with ammonia, *e.g.*, p otosulphate of iron. The most active salts are those whose saline solutions give, with ammonia, precipitates soluble in excess. Zinc covered with metallic deposits is also easily attacked by alkalies. The author considers that the rugosity of the zinc plays a more important part in these phenomena than electricity. By utilising these reactions, the author has devised two methods of photographic engraving.

Action of Ammoniacal Gas upon Nitrate of Ammonia.—F. M. Raoult.—If a stream of dry ammoniacal gas is passed over crystalline nitrate of ammonia, the salt fuses and the gas is absorbed. This phenomenon takes place at ordinary pressure, and at all temperatures from $-15°$ to $+25°$. The liquid, on exposure to the air, loses a part of its ammonia, and deposits crystals containing 1 equivalent of the gas united to 1 of the salt. These crystals continue to lose ammonia till pure nitrate of ammonia remains. An aqueous solution of ammonia dissolves much more nitrate of ammonia than does pure water.

Preparation and Properties of Oxymaleic Acid.—E. Bourgoin.—The new acid differs from maleic acid by 2 equivalents of oxygen, and from malic acid by 2 of hydrogen.

Maleic acid	$C_8H_4O_8$
Oxymaleic acid	$C_8H_4O_{10}$
Malic acid	$C_8H_6O_{10}$

To obtain this acid, the author prepares monobromomaleate of baryta, and precipitates the baryta by sulphuric acid. The monobromomaleic acid thus obtained is saturated with a dilute solution of caustic potassa. The solution of the neutral salt is stirred up in the cold with oxide of silver well washed and recently prepared. The bromine is separated as bromide of silver, and oxymaleate of potassa remains. The filtrate is precipitated with acetate of lead, and the oxymaleate of lead, after washing, is decomposed with sulphuretted hydrogen. The acid is evaporated to dryness and re-dissolved in ether, when it appears in the form of fine elongated crystals arranged in stellar groups. It is white, solid, resembling malic acid in taste, and very soluble in water, alcohol, and ether. It is a bibasic acid.

Acid Derivatives of Naphthylamine.—D. Tommasi.—Naphthylacetamide—

$$\left.\begin{matrix} C_{10}H_7 \\ H \\ C_2H_3O \end{matrix}\right\} N.$$

This body represents acetamide in which 1 atom of hydrogen is replaced by naphthyl, $C_{10}H_7$, and is formed by the action of chloride of acetyl or glacial acetic acid upon naphthylamine. It is prepared by heating 1 part of naphthylamine with 4 parts of crystalline acetic acid to the boiling-point for five to six hours in a cohobator. The contents of the vessel are then poured into cold water, when naphthylacetamide is precipitated. It is thrown on a filter, washed, and re-crystallised from boiling alcohol. It forms white, silky needles, melting at 152°, and capable of sublimation at 160°. It is insoluble in

cold, and sparingly soluble in boiling water; very soluble in hydrochloric, acetic, and dilute sulphuric acids. It does not become coloured on exposure to the air, nor when treated with chromic acid or chloride of lime.

Naphthyl-chloracetamide—

$$\left.\begin{matrix} C_{10}H_7 \\ H \\ C_2H_2ClO \end{matrix}\right\} N.$$

This body differs from the former by the substitution of 1 atom of chloracetyl for 1 atom of acetyl, and is prepared by the reaction of chloride of acetyl upon naphthylamine. It forms silky needles, colourless, fusible, and sublimable at 161°, insoluble in water, but soluble in hot alcohol and acetic acid. It gives no colour with chromic acid and chloride of lime.

Chlorides of Propylene.—E. Reboul.—The normal chloride, $CH_2Cl-CH_2-CH_2Cl$, is the homologue of chloride of ethylene, CH_2Cl-CH_2Cl, or the so-called "Dutch liquor." It has a pleasant odour, and boils at 117°; its density is 1·201 at 15°. Alcoholic potassa, when hot, removes from it hydrochloric acid and changes it into chloride of allyl, and finally into ethyl-allytic ether. Chloro-propylol, $CH_3-CH_2CHCl_2$, is the true homologue of the chloride of chlorated ether, CH_3CHCl_2. Bromides of propylene are known, corresponding to three of the chlorides. The fourth, bromopropylol, might doubtless be formed by the action of perbromide of phosphorus upon propylic aldehyde. The author announces his intention of examining the chlorobromides of propylene.

Note on the Solar Cyclones, with a Reply from M. Respighi to MM. Vicaire and Secchi.—M. Faye.—M. Respighi, in his letter, asserts the excellence of his telespectroscope (called in question by P. Secchi). The chromosphere may appear, as P. Secchi says, more elevated where the spots are by a simple effect of perspective, the surrounding faculæ being projected on each other; but having carefully watched the progress of the spots in periods of quiet especially, he (M. Respighi) had often observed depression at the spot, the red layer being almost interrupted. He also urges that the rarity of reversal of spectral lines in the nuclei is a proof of the small thickness of the chromosphere there; if it were as thick and as largely mixed with luminous jets as neighbouring parts one should be constantly seeing a reversal of the lines. The reversal when observed is doubtless due to the projection of an intense jet or protuberances on the spot. M. Faye remarks on the complexity of the spot phenomena; including faculæ, jets emanating from them, depression at spot axis, the spot itself, and the solar rotation causing it, all in mutual dependence.

Note on the Mechanical Properties of Different Bronzes.—M. Tresca.—The writer arrives at the conclusion that there are bronzes more homogeneous, ductile, resistant, and elastic than those produced in the State foundries; and he calls on the Artillery Department to examine the products of private works so as to determine the bronze most serviceable for cannon.

Electro-Diapason with Continuous Movement.—Second note by M. Mercadier.—(The first appears in the previous page.)—Numerical results are cited as showing that the vibrations are synchronous, notwithstanding the intermittent action of the electro-magnet. The amplitude of the vibrations depends on the form of diapason, on the distance of the electro-magnetic poles from it, on the height at which the magnet stands, on the intensity of the current, and on the nature and length of the style.

Experiment in Electro-Dynamics.—MM. Planté and Niaudot-Breguet.—If a secondary couple (of lead plates) be charged with a Gramme magneto-electric machine, and then be left undischarged in connexion with the machine which has been stopped, the latter presently begins to turn under influence of the current from the secondary couple in the same direction as it was turned in charging; and continues turning (more slowly, indeed, yet at a considerable rate) for two or three minutes till the couple is discharged. In this restitution there is, probably, only slight loss. That the machine in its motion should turn in the same direction as before seems paradoxical, but may be explained by the laws of currents. Further, the secondary couple once charged gives a current more powerful than that produced by the machine which it puts in motion, the difference of intensities continuing the motion.

Remarks on some Peculiarities Observed in Researches on Spectrum Analysis.—L. Lecoq de Boisbaudran.—In passing the induction spark between two metallic pieces the spectral lines are chiefly or exclusively obtained at the negative pole; but with aluminium the contrary occurs. Certain solutions examined with the spark only give the air spectrum, even when negative; by moistening the exterior platinum wire this may be avoided. The presence of metallic molecules in the interpolar space enfeebles the air spectrum. The exterior wire may be brought nearer the solution when the latter is positive than when it is negative, in the latter case the liquid tends to meet the wire. The projection of the liquid in droplets; its *pulverisation* increases so rapidly with the length of spark, and varies with the liquid. The dilution of liquors influences the relative intensities of the lines. When, after long calcination in a gas-flame, there is hardly a trace of matter on the platinum wire; it is not always the lines originally brightest which persist longest. With the spark many metals do not give lines when in the compact state, but furnish beautiful spectra when finely divided. It would sometimes be of advantage to mix the metals with pure lead, from which the spark should be brought.

Classification of Absorption Bands of Chlorophyll.—M. Chautard.—The author divides the chlorophyll bands into three distinct categories. The first contains simply the band in the middle of the red; this he calls the *specific band*. In the second he includes all bands which have been observed in chlorophyll solutions, new or old, neutral, acid, or alkaline; these he calls *supernumerary bands*. The most remarkable is that which results from division of the specific band in the red, under the influence of alkalies. The third category comprises *accidental bands*, not having the permanent character of the preceding, and being produced in special conditions. Of this kind is that from a division of the specific band through acids. The additional band here seems to arise from the less refrangible side, while in the alkaline solution it arises from the other. The author gives several particulars as to the method of treating chlorophyll in order to obtain various bands.

Experimental Researches on the Influence of Changes in Barometric Pressure on the Phenomena of Life.—P. Bert.—Reserved for translation.

On Different Electric Movements Observed in Connection with the Interrupted Lightning Conductor of Greenwich Observatory.—M. de Fonvielle.—The writer pivoted a needle (by its centre) excentrically on a copper disc connected with the aërial rod of the conductor, and observed oscillatory movements in it, which he compares with what has been noticed by other observers.

Revue Universelle des Mines, de la Metallurgie, des Travaux Publics, des Sciences et des Arts Appliqués a l'Industrie, January and February, 1873.

Note on the Furnace of Danks.—Victor Tahon.—The author sums up the results of his examination of this furnace as follows:—The apparatus of Danks is a practical conception, capable of regular and prolonged employment. It suppresses the manual labour of puddling, and replaces it by a mechanical movement which is more advantageous for the purification of the iron.

The result is a reduction of the hands employed and of the expense of labour. The production is strikingly improved alike in quantity and quality.

Note on the Definition of Steel.—A. Greiner.—A mechanical paper.

On Cast Steel obtained by the Bessemer and Siemens Processes.—M. A. Noblet.—The author gives the following analytical results, obtained by Dr. Kezler :—

	I.	II.	III.	IV.	V.	VI.
Graphite ..	2·410	0·75	0·020	0·020	0·010	0·020
Carbon	0·620	2·42	3·170	1·590	0·180	0·190
Silicon	2·410	1·26	0·270	0·030	0·010	0·160
Phosphorus ..	0·130	0·14	0·135	0·130	0·140	0·150
Sulphur	0·024	0·01	0·007	0·013	0·023	0·021
Manganese ..	2·450	0·70	0·190	0·120	0·060	0·220

In this table I. gives the composition of the crude mixture before commencement ; II. to V. the composition of samples taken at various stages of the process ; VI. that of the finished metal. Another investigation gave—

	I.	II.	III.	IV.	V.	VI.
Graphite ..	2·52	0·140	0·040	0·010	0·000	0·000
Carbon	1·06	3·650	3·530	2·470	0·290	0·450
Silicon	1·87	1·200	0·640	0·067	0·021	0·083
Phosphorus ..	0·10	0·106	0·096	0·097	0·109	0·104
Sulphur	0·37	0·069	0·061	0·077	0·113	0·080
Manganese ..	1·04	0·230	0·080	0·060	0·050	0·340

I. represents the material ; II. sample taken after four minutes ; III. the beginning of the second period ; IV. the middle of the second period ; V. sample before the introduction of the spiegel ; and VI. the finished metal. These analyses show the utter inability of the Bessamer process to eliminate phosphorus. The author concludes that the employment of ordinary pig-irons for the manufacture of steel is a problem yet unsolved.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxi., No. 4, May 22, 1873.

Distillation of Petroleum-Schists.—Seguin has invented a method of effecting the distillation of these schists, in which the residues of former operations are used as fuel. The combustion takes place in a furnace of peculiar construction, placed below the retorts. In the Autun district alone this process will effect a saving of coal to the value of 1000 francs daily. The oils obtained are of fine quality, and the yield appears to be augmented.

Preservative against Rust.—Common mercurial ointment is found to be remarkably efficacious in preventing the formation of rust upon articles of iron and steel, such as gun-barrels.

Preservation of Alimentary Substances.—Dr. Sacc. —After a series of experiments, carried on uninterruptedly since 1845, the author has come to the following conclusions :—(1). That organic bodies decompose spontaneously, each in a different manner, either with or without access of air, and either with or without the intervention of microscopic animal or vegetable beings. (2). There is only one certain method of preserving organic substances,—that is by removing their vital moisture, totally or in part, by means of a salt which by remaining in their tissues may hinder the entrance of atmospheric air, and prevent the attacks of insects. (3). The salt which best attains this end, as regards speed, quality of produce, and salubrity, is acetate of soda.

No. 5, May 29, 1873.

On Hofmann's Direct Vision Spectroscope.

On Jules Dubosq's Penumbral Saccharimeter.—These two papers would not be intelligible without the accompanying diagrams.

No. 6, June 5, 1873.

This number contains no original chemical matter.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of bleaching-liquor. Henry Deacon, alkali manufacturer, Widnes, Lancashire. November 7, 1872. —No. 3309. Bleaching-liquor is usually formed by causing a mixture of caustic lime, and water to absorb chlorine, and the reaction may be represented by the following formula :—

$$2CaO + Cl_4 + xH_2O = \begin{cases} CaCl_2 \\ CaCl_2O_2 \end{cases} + xH_2O ;$$

but if the caustic lime be replaced by carbonate of lime, then the reaction may be represented as follows :—

$$CaCO_3 + Cl_4 + xH_2O = CO_2 + H_2Cl_2O_2 + CaCl_2 + (x-1)H_2O,$$

and the result may be described as a mixed solution of chloride of calcium and hypochlorous acid, with liberation of carbonic acid. This solution may be used for bleaching purposes instead of the ordinary bleaching-liquor, or it may be used for the production of pure chlorine by the addition to it of hydrochloric acid, or it may be converted into ordinary bleaching-liquor by the addition of caustic lime, as shown in the following formula :—

$$CaO + H_2Cl_2O_2 + CaCl_2 + (x-1)H_2O = \begin{cases} CaCl \\ CaCl_2O_2 \end{cases} + xH_2O.$$

Now my invention consists in using certain kinds of carbonate of lime to replace wholly or in part the caustic lime usually employed. One of the kinds of carbonate of lime I employ is that procured in a state of fine division by causticising solutions of the carbonates of soda or of potash. This finely divided material is usually a mixture of caustic lime with carbonate of lime, and may be used with water instead of caustic lime, and be impregnated with chlorine in the usual bleaching-liquor making apparatus, too well known to need description. The other kind of carbonate of lime I employ is chalk or limestone in lumps. I fill towers, or columns, or other vessels constructed of stone or other suitable materials, with such lumps of chalk or limestone, which are continually moistened with water, or with weak liquor produced in the course of the manufacture, and I pass chlorine gas or gases containing chlorine through the apparatus amongst the lumps of chalk or limestone. Carbonic acid gas is evolved and escapes, and a solution is obtained which may be described as containing free hypochlorous acid and chloride of calcium, which can be used as a bleaching-liquor, or it may be used for the production of pure chlorine by the addition to it of hydrochloric acid, or be converted into ordinary bleaching-liquor, by the addition of lime as before described. This improvement is especially applicable to the manufacture of bleaching-liquor by the aid of chlorine gas when mixed with carbonic acid gas, or otherwise diluted.

Improvements in the manufacture of salts and oxides of lead and in apparatus therefor. William Marriott, manufacturing chemist, Huddersfield. November 8, 1872.—No. 3322. My improved apparatus for reducing the lead to powder is constructed somewhat on the principle of the "Gifford" injector. My apparatus for converting the lead powder into carbonate of lead has a cylinder with an agitator fixed on a vertical central hollow shaft connected with a pipe whereby steam air and carbonic acid are admitted to the said shaft and to the agitator. The cylinder is supplied with water, and as the lead rises to the surface of the water it passes away through suitable exit pipes in the form of carbonate of lead.

Improvements in the manufacture of stearic acid. Alexander Melville Clark, patent agent, 53, Chancery Lane, Middlesex. (A communication from Edouard Deiss, of Marseilles, France). November 8, 1872.—No. 3323. The invention consists in the application of sulphuret of carbon or other solvent producing similar results for increasing the fluidity of the oleic acid contained in fatty acids so as to facilitate its separation from stearic acid in a cold state without the use of hot pressure as heretofore. The invention is also applicable for extracting the margarine from the residues of all kinds of animal and vegetable oils, and also for the preparation of oleine from tallow for lubricating purposes.

An improved process of tanning hides and skins. Charles de Sainte Marie, doctor, Port Ste. Marie, France. November 9, 1872.—No. 3335. This invention consists—First. In the employment of solutions of the salts of ammonia, such as the chloride, acetate, azotate, and oxalate, but especially the sulphate, for the purpose of neutralising the alkalies used for removing the hair. Secondly. The employment of combined solutions of sulphate of soda and sulphate of ammonia for cleansing, preparing, and de-alkalising mucous, papillary, or other membranes.

Improved apparatus to be used in the treatment of sewage deposits and other like substances. Major-General Henry Young Daracott Scott, C.B., Ealing, Middlesex. November 11, 1872.—No. 3355. This apparatus consists of a drying floor of a corrugated or indented form, but with the elevations on the upper side so sloped as not to allow of permanent lodgments of matter upon them. In the hollows on the upper side archimedean screws are kept in rotation, and by so doing they constantly thrust forward the material to be dried.

Improvements in the treatment of human fæcal matters, and in the apparatus or means employed therein. James Alexander Manning, Inner Temple, London. November 11, 1872.—No. 3356. This invention consists :—First. Of a mode of assisting heating the tank employed for evaporating fæcal matters described in the Specification of the Patent No. 2269, A.D. 1869, by utilising for that purpose the mixture of carburetted hydrogen gas and air evolved during the process of evaporation. Secondly. In introducing steam into the evaporating

chamber through the shaft of the agitator, which is made hollow and is perforated on its under side for that purpose. Thirdly. Of an improved arrangement of water-closet, whereby the fœcal matters are discharged into a separate vessel in lieu of into the sewer, the water employed for flushing the closet being alone discharged into the sewer.

NOTES AND QUERIES.

"Experiments with the Torsion-Rod for Determining the Mean Density of the Earth," forming vol. xiv. of the *Memoirs of the Royal Astronomical Society*. By Francis Baily, Esq., Vice-President of the Society. London. 1843.

P. 71.—A series of 44 experiments mentioned on this page "seem to indicate that it is the lightness of the balls that causes the discrepancies noticed on the recent occasions."

"I made 36 experiments in this manner" [with ivory balls]; "and found that the discordances were still more considerable than any which I had ever yet experienced with other balls, not only in the positions of the resting point, but also in the time of vibration. In fact, the experiments made on January 17, are so anomalous, that I have been obliged to divide them into *three* portions."

P. 72.—"The experiments made on January 20th exhibit similar irregularities. . . . . The six remaining experiments on this day present so many anomalies that the results are not entitled to much credit. For, the arc of vibration, in experiments 1539 and 1543, *in*creased instead of being diminished; which evidently showed that some unlooked for disturbing force was in active operation, which affected with great irregularity both the time of vibration and the march of the resting point."

P. 72.—" . . . . . there is sufficient discrepancy to show that these light balls" [ivory] "are not the best adapted for giving uniform results, whether suspended by silk or iron."

"The experiments on January 28 assimilate to those made on January 20, inasmuch as there is great irregularity in the time of vibration and in the march of the resting point; and likewise in the circumstance that the arc of vibration, in experiment 1598, *in*creased instead of being diminished, and that the last of the single results is very discordant."

P. 73.—"Not being able by these proceedings to throw any light on the cause of the discrepancies so frequently met with in these cases, I conceived it might be occasioned by a slight *twisting* of the suspension lines: for on a close examination of the lines which were now in operation, I observed that they were not exactly in the same vertical plane, there being nearly 30° difference between the upper and lower positions."

P. 74.—"As I was desirous of ascertaining the true cause of the discordances that still existed at every slight change of the apparatus, I resolved on pursuing some further experiments with different balls, where no other alteration whatever (except the change of the balls) should be made in the arrangement or disposition of the apparatus . . . . . ."

P. 75.—" . . . These 60 experiments . . . afford satisfactory evidence that, when the same mode of suspension is adopted, the slight differences that arise are principally caused by the difference in the weight of the balls successively attached to the torsion-rod. Other causes of difference, however, may be suspected to arise from a variation in the mode of suspension."

P. 77.—"It must be confessed that the results, with these light balls, have not in general been so accordant as those obtained with the heavier ones."

P. 78.—" . . . . those anomalies which, however trifling in their effect upon the general result, evidently showed that some disturbing force was in operation that had hitherto escaped detection. The discordances most difficult of solution were those that occurred when the light balls were employed; more especially when the ivory balls were used."

MEETINGS FOR THE WEEK.

TUESDAY, 17th.—Anthropological, 8.
—— Zoological, 8.30.
WEDNESDAY, 18th.—Meteorological, 7. Anniversary.
THURSDAY, 19th.—Royal, 8.30.
—— Philosophical Club, 6.
—— Chemical, 8. Horace Brown, "On the Influence of Pressure upon Fermentation; Part II." Dr. J. H. Gladstone and A. Tribe, "Researches on the Action of the Copper-Zinc Couple on Organic Bodies (III.), and on Normal and Isopropyl Iodides." Dr. J. H. Gladstone, "On Cymenes from Different Sources Optically Considered." W. H. Perkin, "On the Action of Bromine on Alizarine." E. L. Mayor and C. R. A. Wright, "On Some Decomposition and Oxidation Products of Morphine and Codeine Derivatives." R. Warington, "On the Decomposition of Tricalcic Phosphate by Water." J. B. Hannay, "On a New Tellurium Mineral, with Notes on a Systematic Mineralogical Nomenclature." Dr. H. E. Armstrong and C. L. Field, "Communications from the Laboratory of the London Institution; No. XII. On New Derivatives of Cresol."

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THE CHEMICAL NEWS.

VOL. XXVII. No. 708.

ON PHENOLCYANINE.

By T. L. PHIPSON, Ph.D., F.C.S., &c.

THIS new substance is derived from phenol, and appears to me to possess considerable interest, from the analogies it presents with certain colouring matters derived from lichens, and inasmuch as it may perhaps throw some light on the constitution of indigo. It is obtained directly from phenol by dissolving the latter in alcohol, adding liquid ammonia, and allowing the mixture to remain for some weeks in a partially-closed flask; but, in about fifteen days, when the liquid has become a rather dark green, twice its volume of water and one quarter of its volume of ammonia are added, and the mixture is left to itself for about six weeks. By this time the liquid has taken a very fine blue tint, very dark, and a certain quantity of phenolcyanine is found at the bottom of the vessel and adhering strongly to the glass. That which remains in solution can be collected by saturating the liquid with salt. The product is thrown on a filter, and the new substance dissolved in hot alcohol or benzol, from which it is obtained by evaporation.

Properties.—Thus obtained, phenolcyanine is a resinous substance of a very dark blue, nearly black, and showing metallic copper-coloured reflections like indigo. In alcohol, it forms a fine deep blue solution, in ether a reddish purple-blue, and in benzol a reddish purple solution. Concentrated sulphuric acid dissolves it easily, forming a bluish green liquid; hydrochloric acid has little action; and nitric acid forms a nitrous compound very different from picric acid. Phenolcyanine is very slightly soluble in water, but dissolves in hydrated alcohol to which ammonia is added, and this solution can be considerably diluted with water. These alkaline solutions are deep sky-blue by day, but of a vinous red by night or when a flame is seen through them. Acids redden these solutions, and alkalies bring back the blue, as with litmus. Nascent hydrogen reduces phenolcyanine, and renders it completely colourless, but when the solution remains exposed to the air in presence of ammonia the blue colour soon returns. A mixture of ferrous sulphate and lime does not destroy the colour of phenolcyanine as it does that of indigo-blue; so that the former rather resembles the coloured derivatives of orcine than it does indigo. Phenolcyanine melts very easily, and can be partially volatilised in purple vapour; the remainder is decomposed, and leaves a porous charcoal.

Composition.—My analyses of this new product have not been very satisfactory, on account of the very small quantity which I have yet had at my disposal for this purpose; I believe, however, that I can assign to it the formula $C_{12}H_5NO_2$, or $C_{12}H_7NO_4 = C_{12}H_5NO_2 + 2HO$. According to the most recent analyses, orceine is $C_{14}H_7NO_6$, and indigo-blue $C_{16}H_5NO_2$, so that it is possible both may some day be formed from phenolcyanine. I hope to be able soon to refer to its composition again.

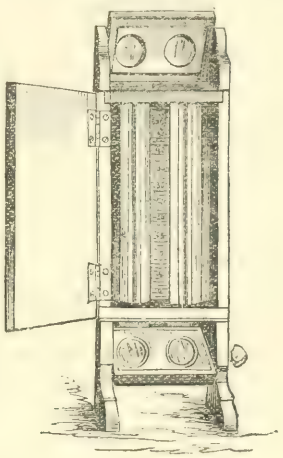
COLORIMETRIC ANALYSIS.

By GEORGE E. DAVIS.

IN the CHEMICAL NEWS, vol. xxvii., p. 262, Mr. Sidney Harvey has devised a colorimeter very similar to one devised by myself, which I have had in constant use for over three years; in fact, Mr. Harvey's instrument is almost an exact counterpart of my original colorimeter, which I was obliged to modify completely before I could depend upon its indications.

The above is an engraving from a photograph of the colorimeter as it is now in use. I may describe it thus:—It consists of a mahogany box, 6 ins. by 3 ins., and 1¼ ins. deep, into which can be inserted two white glass tubes with flat bottoms. The tubes themselves are 6½ ins. long, and ⅞ in. in diameter; the holes upon which they rest are ¾ in. in diameter; and half of the foot-board is cut away to ⅝ in., in order to admit and to steady the tubes. The tubes are placed 1½ ins. from centre to centre, and between the tubes is a scale, preferably graduated into millimetres. The tops of the tubes are held in position by the top of the case, being made so that half takes away; then the tubes are easily abstracted for emptying, cleaning, &c. Now above the tubes is a mirror swinging upon a pivot on each side, which serves to throw the light *down* the tube, and *below* is a similar mirror for *observation*.

If the tubes are now partly filled with standard ammonia which has been Nesslerised, and if the light be thrown up the tubes, we shall see a great deal of the white glass in the top mirror, which prevents to a great extent the exact colour being obtained; and the greater the difference in



level of the liquid in the tubes, the greater the amount of interference in the tint.

Nor is this all to be guarded against, for the tubes ought to be made of the same glass to give accurate results. This fact manifested itself to me in December, 1870, when one of the tubes was broken, and before using the colorimeter, whatever tubes are employed, it should be tested by filling the tubes to an equal height with a coloured liquid, when, of course, the discs upon the mirror should be identical. My instrument is always used in a vertical position, the top mirror throwing the light through the tubes down upon the bottom mirror; the bottom of my tubes are *flat*, and the size of the mirrors 3 ins. by 2¼ ins.

My method of procedure is nearly similar or it may be styled identical with Mr. Sidney Harvey's. It is thus—I take 100 c.c. of the solution in which the ammonia is to be determined, add Nessler, shake, and allow to stand for a quarter of an hour. With this solution I fill one of the tubes half-full, and notice the tint on the mirror below. I then make a solution to correspond as nearly as possible (with my standard ammonia) to the solution in the other tube, and enter it in the note-book as containing *n* milligrammes of ammonia in a litre. This solution, 100 c.c. of which have been Nesslerised, is then added in the empty tube by a fine pipette until the discs appear the same below. Now, supposing the unknown solution stood at a height of 37 m.m. in one tube, and the standard solution in order to obtain the same tint was added until 49 m.m. was reached; then, if this standard solution, contained

0·7 milligramme in a litre, the quantity of ammonia in the unknown solution would be—

$$\frac{0{\cdot}7 \times 49}{37} = 0{\cdot}92.$$

I first arranged this apparatus in June, 1870, and did a deal of work with it in water analysis until February, 1871. In March, 1871, it was used in a series of experiments upon the estimation of carbon in cast-iron, and since then it has been used by several chemists in different researches where quantitative determination by depth of colour could be performed.

Walsall, June 11, 1873.

INFLUENCE OF OPTICALLY-INACTIVE SOLVENTS ON THE ROTATORY POWER OF OPTICALLY-ACTIVE SUBSTANCES.

This subject is discussed by Dr. A. C. Oudemans in a recent number of *Poggendorff's Annalen*.

Reviewing the work of previous observers, he states that Biot, having found (simultaneously with Seebeck), in the year 1815, that circular polarisation was obtainable from a liquid of organic origin, viz., oil of turpentine, was led to a series of researches, from which it appeared that many other liquids, both purely organic compounds, and solutions of solid organic substances in some inactive liquid, gave the phenomenon in varying measures. For use of comparison, in studying the laws of circular polarisation, Biot adopted the expression *specific or molecular rotatory power*, meaning thereby (for a determinate ray of light) the turning of the plane of polarisation, caused by a layer of the active substance 1 decimetre thick, having a degree of concentration = 1, and a density = 1. Hence, if α denote the directly-observed turning of the plane, for a layer l decimetres thick, of a simple solid or liquid combination whose density is δ, the specific rotatory power (α) of this substance will be $= \frac{\alpha}{l.\delta}$.

For solutions of active substances in inactive liquids, the formula takes the form—

$$(\alpha) = \frac{\alpha}{\varepsilon.l.\delta},$$

where ε denotes the degree of concentration, *i.e.*, the relation between the weight of the active constituent and that of the entire liquid.

Biot inferred, from his earlier experiments, that the specific rotatory power (say, S.R.P.) of a dissolved active substance was independent of the degree of concentration; but he afterwards perceived that what he had considered a common case was the exception, and not the rule. With tartaric acid, especially, was the influence of concentration conspicuous.

It was further established, by Biot and others, that temperature had some influence on the S.R.P. of active substances in solution.

The influence of the *nature of the solvent* has been only slightly investigated. In chemical handbooks it appears to be often taken for granted that the S.R.P. is not affected by the solvent, where the latter has no so-called chemical action on the active substance. Biot and Jodin have published a few observations on the point; the former having examined the different effects, on rotatory power of tartaric acid, of water, alcohol, and wood-spirit used as solvents; while the latter found the rotatory power of inverted sugar affected differently by water and by alcohol.

Unacquainted with the influence of inactive solvents now referred to, Dr. Oudemans was accidentally led to study the subject when examining the rotatory power of sulphate of cinchonine. Merely to facilitate solution of the salt in water, which was taking place very slowly, he added some alcohol, not expecting this would affect the rotatory power. Several experiments thus made, with different quantities of alcohol, gave such different results, optically, as could only be attributed to the alcohol added.

In prosecuting the inquiry to which he was thus attracted, he used one of Wild's polaristrobometers and the lime-light. The solutions were brought to a temperature of 17° or 18°. [Sundry other details are given as to the mode of preparing the solutions, &c.] The following table shows the principal results:—

Substance examined.	Solvent.	Degree of Concentration.	Specific Rotatory Power. Degrees.
Cane sugar ..	Water.	0·056	R 66·9
,,	Alcohol 50 p.c.	0·050	R 66·4
Light cubebin oil	Unmixed.	—	L 40·8
,,	Alcohol.	0·061	L 41·6
,,	Benzol.	0·060	L 41·6
,,	Chloroform.	0·075	L 41·7
Cinchonine ..	Alcohol.	0·006 – 0·008	R 228·0
,,	Chloroform.	0·004 – 0·005	R 212·0
Sulphate of cinchonine	Water.	0·014	R 169·0
,,	Alcohol.	0·023	R 191·0
,,	,,	0·055	R 193·0
Nitrate of cinchonine	Water.	0·020	R 154·0
,,	Alcohol.	0·022	R 172·0
Hydrochlorate of cinchonine ..	Water.	0·016	R 162·0
,,	,,	0·026	R 158·0
,,	,,	0·031	R 156·0
,,	Alcohol 93 p.c.	0·054	R 175·0
Brucin	Alcohol.	0·054	L 35·0
,,	Chloroform.	0·019	L 127·0
,,	,,	0·049	L 119·0
Podocarpic acid	Alcohol.	0·040	R 136·0
,,	Alcohol 93 p.c.	0·090	R 136·0
,,	Ether.	0·040	R 130·0
,,	,,	0·070	R 130·0
Podocarpate of soda	Water.	0·046	R 82·0
,,	,,	0·064	R 79·0
,,	,,	0·138	R 73·0
,,	Alcohol.	0·090	R 86·0
Phlorizin	,,	0·046	L 52·0
,,	Wood-spirit.	0·039	L 52·0

This affords sufficient evidence that, while sometimes (as in the case of phlorizin) the S.R.P. of an active substance is not perceptibly modified by the solvent; still, as a rule, the use of different solvents, in circumstances otherwise similar, produces greater or smaller differences. With cane sugar, only a slight difference is observed. The differences are very great in the case of alkaloids and their compounds. The rotatory power of brucin is, in the chloroform solution, nearly one and a half times as great as in the alcohol solution. It is possible that all alkaloids behave generally like cinchonine and brucin in this respect.

In the course of his experiments, Dr. Oudemans observed the curious fact that the S.R.P. of cinchonine in solution with mixtures of alcohol and chloroform is modified in quite a different way from what might naturally be expected from the influence of the two liquids separately. Thus, in the above table, the value of (α) for cinchonine dissolved in alcohol = R 228°; and for cinchonine dissolved in chloroform = R 212°. One might anticipate that, with mixtures of both solvents, the values of (α) would lie between these numbers, and would be greater the more alcohol there was in the mixture, and *vice versa*. It is not so, however, as the following table shows:—

No.	Composition of Solvent.				Value of (a). Degrees.
1.	100·00 p.c.	$CHCl_3$	+ 0·00 p.c.	C_2H_6O	R 212·0
2.	99·66 ,,	,,	+ 0·34 ,,	,,	216·3
3.	98·74 ,,	,,	+ 1·26 ,,	,,	226·4
4.	94·48 ,,	,,	+ 5·52 ,,	,,	236·6
5.	86·95 ,,	,,	+ 13·05 ,,	,,	237·0
6.	82·26 ,,	,,	+ 17·74 ,,	,,	234·7
7.	65·00 ,,	,,	+ 35·00 ,,	,,	229·5
8.	44·29 ,,	,,	+ 55·71 ,,	,,	226·6
9.	27·54 ,,	,,	+ 72·46 ,,	,,	227·6
10.	17·02 ,,	,,	+ 82·98 ,,	,,	227·8
11.	0·00 ,,	,,	+100·00 ,,	,,	228·0

It appears, from the numbers thus obtained (and which Dr. Oudemans represents in a curve),—

(1). That, in alcoholic solution of cinchonine, about the half of the alcohol may be exchanged for chloroform without the S.R.P. of the cinchonine being notably affected. On the other hand, if, in a solution of cinchonine in chloroform, only 1-300th of the solvent be exchanged for alcohol, the S.R.P. is already altered 4°.

(2). The S.R.P. of cinchonine is about a maximum when the solvent mixture contains 10 per cent alcohol and 90 per cent chloroform.

(3). From the influence which two liquids have separately on the S.R.P. of an active substance, no inference can be drawn as to the effect of a mixture of them.

On the last account it is important, in examining the S.R.P. of active substances, to ascertain the purity of the solvent used.

Dr. Oudemans next sought to determine whether the influence of different solvents on the S.R.P. of an active substance was connected with the greater or less solvent power of liquids for the active substance. If this were the case, the S.R.P. of an active substance should probably be more modified by an inactive liquid in which it is easily dissolved, than by one in which it is dissolved with difficulty.

To test this, he determined the solubility of cinchonine in alcohol, in chloroform, and in mixtures of these liquids. The results are as follows:—

No.	Composition of Solvent.				Percentage Quantity of Dissolved Substance. (Weight of solvent = 100.)
1.	100·0 p.c.	alcohol	+ 0·0 p.c.	chloroform.	0·77
2.	90·9 ,,	,,	+ 9·1 ,,	,,	0·94
3.	77·6 ,,	,,	+ 22·4 ,,	,,	1·27
4.	64·9 ,,	,,	+ 35·1 ,,	,,	1·83
5.	47·7 ,,	,,	+ 52·3 ,,	,,	3·30
6.	34·9 ,,	,,	+ 65·1 ,,	,,	4·84
7.	27·4 ,,	,,	+ 72·6 ,,	,,	5·67
8.	22·8 ,,	,,	+ 77·2 ,,	,,	5·88
9.	18·2 ,,	,,	+ 81·8 ,,	,,	5·81
10.	7·8 ,,	,,	+ 92·2 ,,	,,	4·14
11.	1·9 ,,	,,	+ 98·1 ,,	,,	1·34
12.	0·0 ,,	,,	+100·0 ,,	,,	0·28

With these data he constructs a curve of solubility, and it appears—

(1). That the solubility of cinchonine in chloroform is smaller than in alcohol.

(2). That, starting from the two zero points, the solubility of cinchonine, with increasing quantities of chloroform, rises much less than with increasing quantities of alcohol.

(3). That cinchonine is most soluble in a mixture of 20 per cent alcohol and 80 per cent chloroform.

Comparing the curve here obtained with the former curve, they appear to resemble each other, in that both the S.R.P. and the solubility of cinchonine rapidly rise with the increase of the alcohol contents, and also that a smaller solubility of alcohol in chloroform corresponds to a smaller S.R.P. They differ, inasmuch as the maximum of solubility does not coincide with the maximum of S.R.P., and the substitution of chloroform for alcohol immediately modifies the solubility, but not the S.R.P.

Still Dr. Oudemans considers that the solubility and the S.R.P. of active substances stand in a certain connection. For the present, one is not in a position to explain satisfactorily the differences in the two curves; he suggests, however, that possibly, in mixture of the two liquids, other actions take place which affect the S.R.P. Thus it may be that something of the same kind takes place as was observed by Dupré and Page in mixtures of alcohol and water, with reference to specific heat; viz., that some mixtures have a greater specific heat than the individual constituents. In such a case, perhaps the S.R.P. might be affected by the thermic condition of the solvent, as well as by the influence of solubility.

In agreement with the supposition that greater values of (a) for the same active substance always correspond to a greater solubility in the solvent used, are the numbers given in the first table in this paper.

A. B. M.

ON THE

EFFECTS PRODUCED BY ELECTRIC CURRENTS ON MERCURY IMMERSED IN DIFFERENT SOLUTIONS.*

By M. Th. Du MONCEL.

In a former communication the author had considered the secondary current which appears at the same time as the current of polarisation to be caused by some action resulting from the combination of the two gases liberated at the electrodes. He now finds the action is more complex, consisting chiefly in amalgamation of metals in the saline solution with the mercury, under electric influence.

When mercury forms the negative electrode in an electrolyte, the force of the secondary currents depends on the oxidability of the metal added (to the mercury), the concentration of the solution, the facility of union between the metal and the mercury, and the stability of the saline combination. The continuance of the current's action is proportional to the time of electrolysation, and various circumstances affecting the union of metal with mercury. A small proportion of a salt capable of furnishing an energetic secondary current, introduced into a saline solution not thus capable, gives it the power of producing intense currents. Thus, a solution of pure sulphate of bioxide of mercury, with a negative mercury electrode, gives hardly any current; but a few particles of bicarbonate of soda or sulphate of zinc added will furnish a very strong current.

When the mercury forms the positive electrode, the energetic secondary currents produced arise most often from oxidation of the mercury, and the reduction of salts which result from it, by hydrogen condensed on the negative electrode. These currents are much more durable than those formed at the negative electrode. The most important obtained were from solutions of sulphate of soda, sulphate of zinc, sulphate of iron, and chlorhydrate of ammonia. M. Du Moncel gives a table of the results from some twenty different solutions.

PROCEEDINGS OF SOCIETIES.

ROYAL DUBLIN SOCIETY.

A COURSE of four lectures are being delivered at present by Dr. J. Emerson Reynolds upon Spectrum Analysis. These lectures are free to the public, and at the conclusion of the course a spectroscope is to be given away as a prize

* Abstract.

for the best answering. The fourth or concluding lecture takes place on Friday next, when a description of the practical applications of the spectroscope will be given. No expense has been spared as regards the illustrative experiments connected with the course, and we need hardly say that they have proved eminently successful in the hands of Dr. Reynolds.

ROYAL GEOLOGICAL AND ZOOLOGICAL SOCIETIES OF IRELAND.

THERE was a joint meeting of the above societies on Wednesday, June 11, Prof. Hull, Director of the Geological Survey of Ireland, in the chair.

Prof. MACALISTER exhibited a specimen of the *Hippopotamus Liberiensis*, and contrasted its anatomy with the extinct species.

Prof. C. R. TICHBORNE then read a paper on the "*Formation of Minerals having the Spherical or Radical Form.*" The object of this paper was to prove that many minerals, such as wavellite, were actually separated in the colloid form as a fluid non-homogeneous with the menstruum from which they are deposited.

A discussion followed, in which Profs. Sullivan, Reynolds, and Hull took part.

Mr. HARDMAN'S paper, "*On the Occurrence of Zinc in the White Chalk of the County of Tyrone*," was read in the absence of the author.

CORRESPONDENCE.

ACETAMIDE AND ETHYLATE OF SODIUM.

To the Editor of the Chemical News.

SIR,—I observe, in your report of the meeting of the Chemical Society on June 5, an account of a paper by Mr. Hartley on the above subject.

According to Mr. Hartley, acetamide, when heated with methylate of sodium, gives *no* methylamine, and, when heated with ethylate of sodium, it gives *no* ethylamine. In both instances, however, Mr. Hartley observed the evolution of ammonia; but, on making a microscopic examination of the solid product in the latter instance, he found it to consist "merely of feathery crystals of acetamide enclosed in plates of sodium ethylate." Whereupon, as appears from your report, the President thanked the author for the care and perseverance with which he had conducted his experiments.

Possibly it did not strike the President that there was any absurdity in finding that a mixture of acetamide and ethylate of sodium loses ammonia, and, having done so, consists "merely of feathery crystals of acetamide enclosed in plates of sodium ethylate."

The other objection to the results of Mr. Hartley's microscopic examination, viz., that the crystalline plates of ethylate of sodium are in reality not ethylate of sodium, but a compound of alcohol with ethylate of sodium, which suffers decomposition at the temperature at which acetamide is likely to act upon ethylate of sodium, requires some degree of knowledge of the substances in question in order to be appreciated; but, at any rate, after it has been pointed out to him, the cogency of the former of these objections can hardly fail to be palpable to the President of the Chemical Society.

That neither methylamine nor ethylamine was formed in the experiments is an interesting negative result, and will doubtless perplex chemists who regard methylate and ethylate of sodium as consisting of the alcohol radical bound to the metal by means of oxygen. The experiment of Beilstein published some twelve years ago, and showing that ethylate of sodium and acetic ether yield no trace of common ether, and my own more recent investigations, which showed that these substances yield acetate of ethylene-sodium and alcohol, indicate that there is an equivalent of easily-replaceable hydrogen in ethylate of sodium, and negative the view that ethylate of sodium consists of ethyl and sodium bound together by oxygen.

To me the non-production of methylamine and ethylamine in the above instance appears as a natural result of the theory which I have put forward. According to me, acetamide will either refuse to attack ethylate of sodium, or else it will yield ammonia and acetate of ethylene-sodium. If Mr. Hartley *perseveres* in his investigation, and works in an intelligent manner, he will, I hope, find out which of these alternatives is the true one.—I am, &c.,

J. ALFRED WANKLYN.

London, June 16, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, May 26, 1873.

Estimation of the Luminous Phenomena Produced in the Interior of Transparent Media Animated by Rapid Translation where the Observer Himself Participates in the Translation.—M. Boussinesq.—The following law is enunciated by the author. The luminous phenomena perceived by an observer involved in a common movement of translation with reference to the ether, with the source of light and with interposed media, do not differ from those he would observe on contemplating the same source through the same transparent media if—there being no translation—the density of the ether became, in each respective medium, and for waves of a determinate direction, greater than it is in the proportion of unity to the square of the sum of unity and the quotient of the component of the translation velocity in the direction of the normal to the waves, by the velocity of propagation of the latter in the medium considered.

Electric Balance, and an Electro-Static Phenomenon.—M. Volpicelli.—The law of electro-static action revealed by Coulomb's balance depends on a considerable number of causes or forces as follows:—(1) Repulsion or attraction between the electric charges; (2) curvilinear induction between the two spheres; (3) rectilinear induction between them; (4) the attraction of the substances surrounding the spheres; (5) electrisation of the insulating rods; (6) non-uniformity in the distribution of electricity on the spheres; (7) want of reciprocal rectilinear action of the parts of the charge distributed on the surfaces not facing each other; (8) increase of the initial charges through induction of one sphere on the other; (9) the circumstance that one may not refer entirely to the centre of one of the two spheres the electric charge which acts on the other; (10) the loss during experiment of part of the induced electricity of the first kind, and the diminution thus produced; (11) the imperfect elasticity of the suspension thread, its variability with temperature, and its hygrometric state (if not metallic). Thus it appears that the two investigations of the law, one mathematical, the other experimental, are hardly comparable. M. Volpicelli adds some remarks on an experiment described thus in

Les Mondes :—"Let the knob of a gold-leaf electroscope be touched with a bar of vulcanised caoutchouc electrified negatively by rubbing with cat-fur; then remove the rod. Next bring near to the knob a body electrified negatively; the divergence of the leaves diminishes. This phenomenon would be inexplicable if the electroscope were charged negatively; experiment shows, then, that after removal of the rod there remains an excess of positive fluid." He asks, whence this positive excess, and traces it to the fact that electrified non-conductors (unless moistened) do not communicate their electricity to metals they touch, but act merely by induction.

Researches on the Electricity Produced in Mechanical Actions.—M. Joulin.—Induced by observation of the electrical phenomena produced in belts for the transmission of motion, M. Joulin constructed new electric machines in order to study such phenomena, consisting each of a belt and two pulleys. For the pulleys he used cast-iron, copper, zinc, wood, leather, hardened caoutchouc, wool, and silk. For the belt, leather differently prepared, having a pulverulent coating of talc, resin, or oxides: or a coating of wool, silk, or gutta-percha. The maximum velocity of the belt was 1200 metres; the maximum tension weight 300 kilogrms. The motor pulley rested on fixed, the other on sliding, supports. M. Joulin observed the points at which a metallic sphere (with fine needle attached) brought near the system first became luminous in the dark; and these points, taken together, gave surfaces of equal potential. He states the results for conducting and for non-conducting pulleys; and indicates how the permanent electric state is established in the machine. He finds that the free electricity perceived is the dynamical charge accompanying a current which is propagated through the belt; a charge which, according to Ohm's law, decreases from one extremity to the other of the belt, as the ordinates of a trapezium for conducting pulleys and those of two similar triangles for non-conducting pulleys.

Conditions of Maximum of Magnetic Effect in Galvanometers and Electro-Magnets.—Note by M. Raynaud.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 246, June, 1873.

Notes on the Recent Progress of Chemical and Metallurgical Manufactures of England.—G. Lemoine.—The author reviews the improvements of Weldon and Deacon in the manufacture of bleaching-lime; the use of revolving furnaces in the alkali trade; the utilisation of vat-waste; the preparation of sulphate of soda by the process of Hargreaves; the method of Schlœsing and Rolland for obtaining carbonate of soda by the action of chloride of sodium and bicarbonate of ammonia; the process of Gibbs for utilising burnt pyrites; the manufacture of magnesia and of carbolic acid. (We cannot help pointing out that the results of such a tour of inspection would have been more instructive if undertaken by a chemist instead of an "engineer of bridges and highways." M. Lemoine should remember the proverb, "Chacun à son métier.")

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, May 12, 1873.

Sulphur Derivatives of Cymol.—A. P. Fleisch.—In the preparation of cymol by distilling camphor with the sulphide of phosphorus there are formed, in addition to cymol and other hydrocarbons of the benzol series, a body resembling phenol, soluble in alkalies, and capable of re-precipitation by acids. This substance was found to be a sulpho compound, $C_{10}H_{14}S$, or $C_{10}H_3SH$; a colourless liquid insoluble in water, and miscible with alcohol in all proportions. It boils at 235° to 236°, and has at 17·5° the sp. gr. 0·9975. It may be named thiocymol, or thiosulphydrate. Oxidising agents convert it into cymol-bisulphite $(C_{10}H_{13})_2S_2$. By treating either this compound or the cymol-sulphydrate with nitric acid we obtain sulphotoluylic acid—

$$C_6H_3\begin{cases}CH_3\\CO_2H\\CO_3H\end{cases}$$

By fusing this sulphotoluylic acid with hydrate of potassa two oxyacids are formed. The more soluble oxytoluylic acid consists of—

$$C_6H_3\begin{cases}CH_3\\CO_2H\\OH\end{cases}$$

and is distinguished from the three acids of the same percentage composition by giving no violet colouration with the perchloride of iron. The less soluble of the two acids, when purified by repeated precipitation, gives results on analysis which agree more closely with the formula of dioxybenzoic acid, $C_7H_6O_4$, than with that of oxyterephthalic acid, $C_8H_6O_5$. The formation of the latter is, however, the more probable.

Solubility of Saline Mixtures.—F. Ruedorff.—The author remarks that on this subject little is known beyond the fact that salts are generally more or less soluble in the solutions of other salts than in pure water. He proposes to arrange for this purpose saline mixtures in two classes. I. Mixtures where no chemical change can take place, *i.e.*, salts with identical acids or identical bases. II. Mixtures where chemical changes are possible, *i.e.*, salts with two bases and two acids. The experiments with salts of the same base, or the same acid, showed that with some saline mixtures saturated solutions may be obtained by simply using an excess of both. In other cases the composition of the resultant solution depends on the relative proportion of the two salts submitted to the action of water. A respectively larger amount of either salt modifies the composition of the solution, so that the salts have a power of mutually excluding each other. As a matter of course, in such cases it is impossible to state the composition of the saturated solutions. Of two isomorphous salts the less soluble is expelled from solution by the more soluble.

Action of Ozone upon Pyrogallol.—J. D. Boeke.—The dark colour produced by ozone in an alcoholic solution of pyrogallol gradually disappears on prolonged action, and passes ultimately into an orange or a yellow. Beside carbonic acid and volatile fatty acids there is formed a new crystalline acid, which appears to contain 37·07 per cent of carbon, and 4·88 per cent of hydrogen, corresponding with the formula $C_6H_6O_7$.

Removal of Nitrogen from the Alkaloids.—J. D. Boeke.—The author, with reference to a preliminary communication from Prof. Hlasiwetz on the same subject, finds that when a mixture of quinine with powdered zinc sodium and excess of zinc-powder is heated in a combustion-tube to dull redness, a liquid is obtained with a pleasant smell of carraway, and free from nitrogen. The residue in the tube contained cyanide of sodium. On further experiments cinchonin was found to behave in a similar manner. Quinine may be obtained in fine crystalline needles from solution in chloroform.

Chemical Nature of Desoxybenzoins and Kindred Substances.—Br. Radziszewski.—The author considers desoxybenzoin as a keton. By submitting to destructive distillation a mixture of benzoate and phenylacetate of lime he obtained, amongst other products, benzol-benzyl-keton, $C_{14}H_{12}O$, agreeing both in composition and properties with desoxybenzoin. Benzoin he considers to be at once a keton and a pseudo alcohol.

Action of Bromine upon Boiling Æthyl-Benzol.—Br. Radziszewski.—The product, whether washed with water and dried, or unwashed, was entirely decomposed on distillation. Bromide of hydrogen was liberated in

abundance; the thermometer remained for a time constant at from 145° to 150°, and then rose gradually to 190°. In the retort remained a black mass containing ordinary crystalline bibromstyrol. The distillate behaved in the same manner on re-distillation. Phenylbromethyl, almost pure, can be obtained by acting upon ethylbenzol at the temperature of 140° with a slight excess of bromine. On heating 2 equivalents of bromine with 1 of ethylbenzol to 145° to 150° we obtain a crystalline compound, $C_8H_8Br_2$, identical with bibromstyrol, which, when passed over quick-lime at dull redness, gives two compounds—(1) A liquid hydrocarbon, C_8H_6, boiling at 140°, and identical with Glaser's acetenylbenzol; and (2) a crystalline substance fusing at 119°, and which when dissolved in benzol gives a fine red colour with picric acid. An alcoholic solution of picric acid gives neither a red precipitate nor colouration, which proves the absence of pyeren.

Nitro-Anthracen and its Derivatives.—Ernst Schmidt.—The author seeks to identify as a new product the hydrocarbon which he has obtained, isomeric with anthracen. The similarity of the melting-point (247°) to that of para-anthracen (244°) might lead to the view that both were identical. This is not the case. Not merely the behaviour of the two bodies with reagents, but the phenomena displayed on fusion are quite distinct. Para-anthracen returns on fusion to common anthracen, its melting-point falling from 244° to 213°; whilst the author's hydrocarbon can be fused repeatedly, and even heated to 300°, without undergoing any change of fusibility. The new hydrocarbon on treatment with boiling nitric acid is converted into a yellow nitro product, $C_{14}H_9(NO_2)$, without formation of a trace of chinon. On the other hand, para-anthracen is not nitrised by boiling with concentrated nitric acid; and common anthracen is almost entirely converted into anthrachinon and dinitro-anthrachinon. The behaviour of the new hydrocarbon with bromine differs from that of anthracen. On oxidation with chromic acid, the reaction being carefully moderated by refrigeration, a chinon is produced, $C_{14}H_8O_2$, which sublimes and crystallises in splendid red needles, fusing at 235°, and consequently totally distinct from the pale yellow ordinary anthrachinon, fusible at 273°. The new chinon dissolves in concentrated sulphuric acid with an intense and splendid indigo-blue colour. On the addition of water the colour disappears, and the chinon separates out unchanged. The mononitro product of anthracen, described by Phipson as resulting from the direct action of nitric acid upon anthracen, is not identical with the author's mononitro-anthracen, and its derivative amido-anthracen.

Propyl-Phenyl-Keton.—Ernst Schmidt and E. Fieberg.—Of the compound ketons of the aromatic series which along with phenol contain a radical of the fatty acid series, hitherto only the methyl-phenyl and ethyl-phenyl-ketons, have been examined. The authors have added a new homologue to the series by the preparation of propyl-phenyl-keton—

$$\left.\begin{matrix}C_6H_5\\C_8H_7\end{matrix}\right\}CO$$

It is obtained by the destructive distillation of a mixture of benzoate and butyrate of lime and fractional distillation of the crude product. When purified it is a pale yellow liquid, of a pleasant aromatic odour and burning taste. It boils at 220° to 222°, and its sp. gr. at 15°=0·99. In this keton series there appears a certain regularity in the boiling-points, similar to that observed in the normal ketons of the fatty series. Thus, methyl-phenyl-keton boils at 199°; ethyl-phenyl-keton at 210°; propyl-phenyl-keton at 220° to 222°. On the average the addition of CH_2 raises the boiling-point 11°.

On a Hydrocarbon in Vegetable Fats.—J. Kœnig and J. Kiesow.—The former of these authors has previously stated his opinion that a hydrocarbon containing a higher percentage of carbon must occur along with wax. This supposition they consider verified. They have obtained from hay a fatty matter, which when freed from traces of cholesterine contained—

Carbon	84·96
Hydrogen	15·28
	100·24

fusing at 65° to 66°, and congealing at 65·8° to 65°.

Action of Chlorethyl upon Anhydrous Sulphuric Acid.—Th. v. Purgold.—The main product of the reaction is chlorosulphuric ether, $C_2H_5ClSO_2Cl$. When purified it distils almost entirely between 80° and 96°. The washings were found to contain isaethionic and chlorisaethionic acids. With ammonia chlorosulphuric ether reacts very violently, the mass becoming carbonised except rise of temperature is carefully prevented. With phenol the ether forms a clear liquid, which, if heated in the water-bath to 60°, gives off chlorethyl and hydrochloric acid. The products of the reaction are a thick, turbid, aromatic oil (neutral phenyl-sulphuric ether?), and two sulphacids not yet examined.

Phthaleine of Hydrochinon and Chinizarine.—F. Grimm.—The brownish-red, thick, fused mass, obtained on heating togerher hydrochinon and anhydrous phthalic acid, becomes gradually solid and crystalline when exhausted with boiling water. On treatment with absolute alcohol, and dilution of the extract with water, the colouring matter is first deposited. On heating the filtrate, and adding more water, the phthaleine crystallises out, and can be purified by repeated solution in a little ether, and final crystallisation from alcohol. When pure it is a white body, fusible at 232° to 234° and congealing on cooling to a yellowish vitreous mass. From hot alcohol it crystallises in white felted needles containing 1 equivalent of alcohol. If the solution is much diluted with water the crystals take the form of nacreous scales containing no alcohol, but 1 equivalent of water, which they lose at 160° to 180°. To obtain chinizarine the fused mass of phthalic acid, hydrochinon and sulphuric acid, after having been boiled in water is extracted with absolute alcohol and precipitated with water; or else treated with benzol which dissolves chinizarine readily, but phthaleine sparingly. When purified by re-crystallisation from alcohol and ether it is composed of $C_{14}H_8O_4$. It crystallises from ether in orange scales; from benzol and alcohol in dark red needles. The solutions in ether and in sulphuric acid display a greenish-yellow fluorescence resembling that of Stenhouse's munjistin, prepared from munjeet. This body possibly stands in the same relation to chinizarine as does purpurine to alizarine. When heated chinizarine sublimes in coloured needles and plumose crystals resembling alizarine, leaving a shining charcoal behind. The melting-point of the sublimed body is 194° to 195°; that of the crystals from alcohol 192° to 193°. With alkalies it yields blue solutions with a slightly violet tinge, which is most decided in case ammonia is employed. With baryta it gives a fine blue-violet compound; with alumina a red lake playing into violet; and with magnesia a deep blue-violet body. Chloride of iron gives a brown-red, and acetate of lead a dull red precipitate in the feebly alkaline solution. If the alcoholic solution is allowed to stand for some time it becomes colourless; whilst a deep violet or black precipitate is deposited, which re-dissolves in alkalies with a blue colour. At a boiling heat the alkaline solution is decolourised by zinc-powder, but on exposure to air quickly resumes its colour. Chinizarine is not only isomeric with alizarine, but the two bodies stand in the closest connection. If the vapours of chinizarine are passed over heated zinc-powder we obtain white shining scales which, after sublimation, melt at 210° to 212°, and give a red compound with picric acid. It is highly probable that chinizarine is converted into anthracen

when heated with zinc-powder. The author considers that his results support the view of Fittig that anthrachinon is a double ketone of benzol. The following observations on the absorption spectra of chinizarine and alizarine, due to Prof. Kundt, may be of interest. It should be noted that the alizarine had merely been purified by sublimation, and might, therefore, contain purpurine :—

ALIZARINE. D at 172° of the scale; C at 157·5°.	CHINIZARINE. E, 191°; F, 208·5°; G, 243°.
1. *Solution in Soda Lye.*	
Three dark bands; their centres. (1). 166. (2). 177. (3). 190 (very faint).	Only 2 direct bands visible, their centres. (1). 169. (2). 121.
2. *Solution in Carbonate of Potassa.*	
(1). Dark band above mentioned at 166. (2) and (3) forming a broad washed-out band in which the two maxima of darkness were not easily distinguished.	In a concentrated solution only one band, absorbing the whole blue portion from 167°. In dilute solutions 2 faint dark bands. (1). 171. (2). 184.
Solution in Ether.	
If concentrated no bands visible; the whole blue part absorbed from 190°. If less concentrated a faint dark band at 193° Another band beginning at 205°; behind this a maximum of light, followed again by absorption.	Three bands visible. (1). 195° } Distinct. (2). 201° } (3). 209. Fainter and twice as broad as the former.
Solution in Sulphuric Acid.	
In concentrated solutions a very peculiar faint band at 163°. Appearance of a band at 181°. Dilute solutions; a very faint band at 203°.	In concentrated solutions three bands; in dilute only two. (1). At 183°. (2). At 197°. (3). Very faint at 212°.

Mono-Bromacrylic Acid Obtained from β-Bibromo-propionic Acid.—R. Wagner and B. Tollens.—The authors obtained the acid $C_3H_3BrO_2$ by treating β-bibromo-propionic acid with potassa. It is capable of combining with hydrobromic acid to form a crystalline acid fusible at 63° to 64°, and identical with the bibromo-propionic acid.

α-Bibromo-Propionic Acid Obtained from Propionic Acid.—G. Phillippi and B. Tollens.—The two bibromo-propionic acids differ in crystalline form. A solution of each is induced to crystallise by the addition of a solid particle of its own kind; whilst a portion of the other not only fails to set up crystallisation, but is itself dissolved. The two acids are still more clearly distinguished by their behaviour with nascent hydrogen; the β modification yielding acrylic acid, whilst the α form produces propionic. The respective salts of the two acids are also distinct.

Nature of the Elements.—J. A. Groshans.—(Two papers.) Reserved for complete insertion.

Thermo-Chemical Determination of the Affinity of Oxygen for Sulphur, Selenium, and Tellurium.—Julius Thomsen.—The author concludes that the mutual affinity of oxygen and selenium in both stages of oxidation is smaller than that of oxygen and sulphur, and also than that of oxygen and tellurium, which latter element holds a middle place in the scale. This result may seem unexpected, as it is commonly supposed that the relations of affinity in a group of elements increase or decrease with the atomic weight. Such a proportion occurs in the case of hydrogen compounds when the affinities decrease as the atomic weights increase, as—

Cl > Br > I.

In oxygen compounds this law does not hold good, the affinities of the same group for oxygen being—

Cl > Br < I.

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The same holds good with the group just examined, the affinities for oxygen being—

S > Se < Te.

In both these elementary groups the two first members have the greatest resemblance, in a chemical point of view, and differ more widely from the third.

Notes from the Greifswald Laboratory.—H. Limpricht.—(1). The picrate and dibromide of phenanthren have been formed and examined by Hayduk. The former, $C_{14}H_{10}C_6H_3(NO_2)_3OH$, forms fine yellow acicular crystals, fusible at 143° The dibromide, $C_{14}H_{10}Br_2$, forms four-sided prisms which fuse at 98°, and undergo spontaneous decomposition even in closed vessels. Bromphenanthren, $C_{14}H_9Br$, one of the products of the decomposition of the above salt by heat forms slender white prisms, fusible at 63°. The chinon of phenanthren, $C_{14}H_8O_2$, constitutes orange needles, fusing at 202°. (2). Paulz, in submitting chlorinated sulphide of toluol, $(C_6H_4Cl,CH_2)_2S$, to distillation obtained a compound, $C_{14}H_8S_2$, in white brilliant scales, fusible at 208°, and capable of sublimation without decomposition. (3). Pechmann has succeeded in obtaining the chloride of benzylsulphonic acid, $C_6H_5CH_2SO_2Cl$.

On Isokreatine.—H. Salkowski.—This compound is an isomer of kreatine, obtained by the addition of alanine and cyanamide. It is distinguished from kreatine by taking up no water of re-crystallisation. The aqueous solution, if free from alanine, remains colourless when boiled with oxide of copper.

Ketons Formed from Aromatic Acids and Hydrocarbons.—M. Kollarits and V. Merz.—Reserved for full insertion.

Bulletin de la Societe Chimique de Paris, tome xix., No. 11, June 5, 1873.

Preparation and Properties of Oxymaleic Acid.—Ed. Bourgoin.—We have elsewhere given the substance of this paper.

Claim of Priority raised by J. Thomsen respecting the Principles of Thermo-Chemistry.—M. Berthelot.—A controversial paper.

Action of Hydrochloric Gas upon the Compound Ammonias.—Ch. Lauth.—It is known that "Paris violet" is prepared on the large scale by the action of oxidising agents upon methyl- and dimethyl-aniline, and that these bases are obtained by heating the hydrochlorate of aniline with methylic alcohol under pressure. In the "Neues Handwörterbuch der Chemie," p. 632, Hofmann states that methyl-aniline, thus prepared, contains always methyl-toluidine, and concludes that the formation of the violet is analogous to that of magenta, with the difference that in the former case we operate upon methylated bases. This view does not agree with the following facts:—Methyl-aniline yields, on oxidation, larger quantities of violet the higher is its degree of purity. It seems that, if it were proper to operate upon a mixture of methyl-aniline and methyl-toluidine, it would be simpler to set out with a mixture of aniline and toluidine, instead of a pure aniline. Again, the methyl-aniline, obtained by the action of iodide of methyl upon aniline, yields violet, though the reaction takes place at a very low temperature, whilst the introduction of methyl into the residue C_6H_5 only takes place, according to Hofmann, at an elevated temperature. The presence of methyl-toluidine cannot be

shown in methyl-aniline, either by fractional distillation or bythe fractional crystallisation of salts. A current of dry hydrochloric acid gas was passed into methyl-aniline kept in a state of gentle ebullition, the apparatus being disposed so as to absorb the excess of gas on its exit from the receiver, and to collect the gases formed during the reaction. The presence of the chloride of methyl could not be mistaken. On operating upon 50 grms. of methyl-aniline, more than 30 litres of gas are collected in two or three hours; the disengagement then slackens, but does not entirely cease for two days. When the liberation of chloride of methyl is at an end, the apparatus is cooled. The product becomes a hard crystalline mass, which is dissolved in boiling water and crystallised. The crystals, on treatment with caustic soda, yield pure aniline. This aniline, reproduced from methyl-aniline, does not contain toluidine. In a similar manner, methyl-toluidine, heated in a current of hydrochloric gas, yields chloride of methyl and toluidine, without a trace of aniline. These facts prove that the methyl-aniline employed in the manufacture of Paris violet contains neither toluidine nor methyl-toluidine, and that, contrary to the view of Hofmann, the production of this colour does not require the simultaneous action of methyl-aniline and of methyl-toluidine. The action of hydrochloric acid upon these bases appears to be of general applicability, as it will permit us to recognise the presence of alcoholic groups of the fatty series, simple or substituted, and thus determining the nature of some isomeric bodies.

Method of Analysing Glycerines.—P. Champion and H. Pellet.—Commercial glycerines, according to the manner of their preparation, contain certain foreign bodies, such as glyceric ethers, volatile fatty acids, &c. Samples agreeing in specific gravity and in whiteness may differ in their degree of purity. The following process will be found useful for ascertaining their quality:—An acid mixture is prepared beforehand, consisting of 1 part of fuming nitric acid and 2 parts of pure sulphuric acid at 66° Baumé. The nitric acid should be previously deprived of its hyponitric fumes, by heating it in the water-bath to 80°, and passing through it a rapid current of air until all the colour has disappeared. 250 grms. of the refrigerated mixture are then weighed out, and placed in a suitable flask surrounded with cold water. On the other hand, 30 grms. of the sample of glycerine are weighed out. The glycerine is poured, drop by drop, into the nitrosulphuric mixture, constantly stirring with a thermometer, and taking care that the mixture does not exceed the temperature of 25°. The exact quantity of glycerine employed is then determined by a second weighing of the beaker. After standing for half an hour, the nitroglycerine collects at the upper part of the acid mixture, and the whole is poured into a large earthen vessel containing from 1 to 2 litres of cold water, avoiding too great a development of heat. The nitroglycerine is precipitated in states which vary with the purity of the glycerine operated upon. If a crude, impure sample, has been employed, the product is opaque, and collects with difficulty. In certain cases, it takes the form of clots, which do not unite on shaking. This comes from the interposition of a quantity of water, which forms an emulsion with the nitroglycerine. In order to dry the product, it is saturated with a weak solution of caustic soda. It is washed, and, when the excess of water has been removed, it is mixed with an equal volume of wood-spirit. It is evaporated in the water-bath, and weighed. The water is carried off along with the wood-spirit, and a clear product is obtained, more or less coloured according to the purity of the glycerine. Two successive weighings are necessary to ascertain the total expulsion of the wood-spirit and the water. The preliminary washing of the nitroglycerine is best performed in a tall glass jar, by passing a constant current of water down to the bottom by means of a glass tube. The washing may require from one to two hours. Lime, if present, should be directly determined in a portion of 30 grms. Chemically pure glycerine, concentrated *in vacuo* at 120° to 150°, yields 190 per cent of nitroglycerine. The operator is liable to violent headaches from the odour of the nitroglycerine, which may be treated with ammonia and acetate of morphia.

Determination of Nitroglycerine in Different Species of Dynamite.—P. Champion and H. Pellet.—Dynamites may be divided into two classes, according to the nature of the absorbent:—(1). Those with an inert base, such as silica, Boghead ashes, Tripoli, &c. (2). Those which, like dualine and lithofracteur, contain resin, finely-powdered coal, nitrate of potash or soda, or other bodies which are decomposed on explosion. In examining the former kind, 25 grms. of dynamite are weighed out and exhausted with pure hot methylic alcohol. The solution is then evaporated in the water-bath till the weight becomes constant. Dynamites with an active base are treated with boiling water, which dissolves out nitrates and separates resins, which rise to the surface. The nitroglycerine is then separated from the insoluble residue by means of wood-spirit, as above.

Contributions to the History of Glucinum.—A. Atterberg.—An account of the composition of some of the salts of this metal.

Polytechnisches Journal von Dr. E. M. Dingler, first number for May, 1873.

Account of a Visit to the Nitroglycerine Works of G. M. Mowbray, situated near North Adams, Massachusetts, U.S.—A. Ott.—This lengthy paper contains a detailed account of the method of preparing, on the large scale, nitroglycerine, which is here made with great care, and is, after having been purified, frozen either in bulk or in cartridges. The substance thus made differs in some particulars from Nobel's nitroglycerine; the former freezes at 7·2°, and contracts thereby 1-12th in bulk; the latter freezes at 12·8°, and expands thereby considerably. The American product cannot explode as long as it remains frozen, and is quite as colourless as water. The nitric acid employed in the preparation is manufactured on the premises, and carefully freed from any hyponitric acid, which, according to Mowbray, is an important point in the process. The glycerine is also taken quite pure, and the nitration is conducted very slowly, and aided by keeping the vessels very cold, and, moreover, by minutely dividing the liquid by means of blowing air through it. The crude nitroglycerine is carefully purified, and afterwards frozen.

Estimation of the Oxygen present in the Gases Escaping from the Leaden Sulphuric Acid Chambers.—F. Bode.—This paper contains a series of calculations exhibiting a method of arriving at an approximate result, sufficiently accurate for all practical purposes, as regards the quantity of oxygen present in the gaseous mixture alluded to.

New Industrial Process of Stearine Manufacture.—Professor Bock.—The author points out that the so-called acid saponification is misunderstood, that in reality no saponification takes place at first, and that the preliminary action of the sulphuric acid, when the operation is properly conducted, is to dissolve and disintegrate the albuminous and cellular tissues present in the raw fat, and next to dissociate the neutral fats, whereby the fatty acids may be obtained in a state of great purity.

Testing of Sulphate of Alumina (Patent Alum) for Sulphuric Acid.—J. Reimann.—The pulverised salt is put into alcohol, wherein it is insoluble, while any free sulphuric acid it might contain is soluble therein, and may be estimated by titration after filtration of the alcohol. Pure sulphate of alumina yields, with a logwood decoction, a deep violet colour, but, if free sulphuric acid is present, the colour becomes brown.

Composition of a Pottery Glaze.—Dr. H. Seger.—In 100 parts, the glaze was found to consist of—Silica, 40·56;

alumina, 6·07; oxide of lead, 40·04; peroxide of iron, 2·59; protoxide of manganese, 7·14; lime, 2·58; alkalies, 1·02. This glaze may industrially be obtained by mixing the following ingredients:—Quartz, 28 parts; litharge, 40; pipe-clay, 18; peroxide of manganese, 9; chalk, 5. The substances, finely ground, should be ignited, and next again ground to an impalpable powder, previous to being applied to the potteryware (hard earthenware).

Journal fur Praktische Chemie, No. 1, 1873.

Chemical Constitution of some of the Uranium Metals.—Dr. C. Winkler.—This exhaustive essay treats at length on the composition and chemical constitution of some minerals recently found in Saxony, viz.:—Uranospherite, consisting, in 100 parts, of—Oxide of uranium, 43·79; oxide of bismuth, 38·39; water, 4·84; oxide of cobalt, 4·22; oxide of iron, 2·75; carbonate of lime, 1·15; arsenious acid, 1·82; quartz (silica), 1·05. Formula—

$$Bi_2O_3,2U_2O_3+3H_2O, \text{ or } [U=120]\left\{\begin{matrix}(UO)_4\\Bi_2\end{matrix}\right\}O_5+3H_2O.$$

Walpurgin, in 100 parts—Oxide of bismuth, 61·43; oxide of uranium, 20·29; arsenious acid, 11·88; water, 4·32. Typical formula—

$$[U=120]\left\{\begin{matrix}(AsO)_2\\Bi_5(UO)_3\end{matrix}\right\}O_{12}+5H_2O.$$

Trögerit, in 100 parts—Oxide of uranium, 59·73; arsenious acid, 17·39; water, 17·03; oxide of bismuth, 0·74; oxide of copper, 0·56; oxide of cobalt, a trace; gangue, 1·69. Typical formula—

$$\left\{\begin{matrix}(AsO)\\(UO)_3\end{matrix}\right\}O_3+6H_2O.$$

Zeunerit, in 100 parts—Oxide of copper, 7·49; oxide of uranium, 55·86; arsenious acid, 20·94; water, 15·68. Formula—

$$\left\{\begin{matrix}(AsO)_2\\Cu(UO)_4\end{matrix}\right\}O_6+8H_2O.$$

Uranospinit, in 100 parts—Lime, 5·47; oxide of uranium, 59·18; arsenious acid, 19·37; water, 16·0. Formula—

$$\left\{\begin{matrix}(PO)_2\\Ca(UO)_4\end{matrix}\right\}O_6+8H_2O.$$

Contribution to our Knowledge on Indium.—C. Roessler.—The author prepared an ammonium-indium alum which, on being analysed, was found to contain, in 100 parts—Oxide of indium, 25·47; ammonium, 4·82; sulphuric acid, 26·66; water, 40·04. Formula—

$$In_2O_3(NH_4)_2O,4SO_3,18H_2O.$$

This alum is very soluble in water, but insoluble in alcohol; the acid solution becomes turbid by boiling.

Analysis of the Chalybeate Water of Homburg.—Dr. R. Fresenius.—The source yields 2160 litres of water in twenty-four hours. Sp. gr. of the water at 20°, 1·007080; temperature of the water (that of the air being, at the moment of observation, 11°), 18·75°. 1000 parts of this water contain (the carbonates taken as neutral salts)—Chloride of sodium, 5·863199; chloride of potassium, 0·248320; chlorlithium, 0·012067; chlorammonium, 0·013187; chlorcalcium, 0·497721; chlormagnesium, 0·315457; iodmagnesium, 0·000015; brommagnesium, 0·000676; nitrate of potassa, 0·001874; sulphate of lime, 0·003725; sulphate of strontia, 0·010616; sulphate of baryta, 0·000420; carbonate of lime, 0·722479; carbonate of magnesia, 0·061417; carbonate of protoxide of iron, 0·071385; carbonate of protoxide of manganese, 0·004054; carbonates of the protoxides of cobalt and nickel, 0·000024; basic phosphate of lime, 0·001017; silica, 0·017190; total of fixed constituents, 7·844843; carbonic acid combined with the carbonates, 0·378699; free carbonic acid, 2·042990; sulphuretted hydrogen, 0·000671. The following substances are present in this water in unweighable quantity:—Oxide of cæsium, oxide of rubidium, alumina, oxide of copper, oxide of antimony, arsenic acid, boracic acid, fluorine, organic matter, nitrogen, and marsh gas. 1000 c.c. of water contain 1082·93 c.c. of free, and 200·74 c.c. of combined, carbonic acid, and 0·4583 c.c. of sulphuretted hydrogen.

What is to be considered Good Potable Water?—E. Reichardt.—An hygienico-chemical essay.

Metamorphosis of Bones.—Dr. C. Aeby.—A pathologico-chemical memoir.

No. 2, 1873.

Estimation of Nitric Acid Present in Potable Waters by Means of Indigo.—F. Fischer.—This paper contains, in the first place, a *resumé* of the researches of Marx, Goppelsroeder, Bemmelen, and others, on this subject; and further, the results—chiefly exhibited in tabulated forms—of the author's experiments made with the view to ascertain the correctness of this process: it would appear that, with due care and frequent repetition of the estimation of nitric acid in the same sample of water, reliable results may be obtained.

Artificial Formation of Fluoride of Calcium and of Heavy Spar.—Th. Scheerer and E. Drechsel.

A Very Simple and Rapidly-Acting Method of Filtration, based upon Bunsen's Process.—Dr. E. Fleischer.—This paper is illustrated with woodcuts.

On some of the Derivatives of the Cyan-Carbonic Acid Ether.—A. Weddige.—When the ether is treated with alcoholic ammonia there is formed cyan-ammonium-urethan according to the formula—

$$\left\{\begin{matrix}CN\\COOC_2H_5\end{matrix}\right\}+2NH_3=NH_4CN+\left\{\begin{matrix}NH_2\\COOC_2H_5\end{matrix}\right.;$$

concentrated hydrochloric acid converts the cyan-carbonic acid ether, even in the cold, into oxalic acid and chloride of ammonium. When the free ether or its alcoholic solution is treated with sulphuretted hydrogen there is formed a crystalline, lemon-yellow-coloured substance, soluble in boiling water; fusion-point 63° to 64°. The formation of this body is elucidated by the following formula:—

$$\left\{\begin{matrix}CN\\|\\COOC_2H_5\end{matrix}\right\}+H_2S=\left\{\begin{matrix}CSNH_2\\|\\COOC_2H_5.\end{matrix}\right.$$

By treating the cyan-carbonic-acid ether with sodium amalgam there is not formed a combination corresponding to kyanäthin.

Chemical Constitution of the Benzol Compounds.—Th. Petersen.—This monograph does not admit of abstraction.

No. 3.

Action of Potassium Sulphydrate upon the Aromatic Nitriles.—A. Weddige.—Pure cyan-benzyl, $C_6H_5OH_2CN$, was treated with an excess of an alcoholic solution of potassium sulphydrate, with the view of obtaining the potassa salt of the dithio-alpha-toluylic acid, $C_6H_5CH_2CS_7SK$; but instead of this, the result of the reaction was the formation of a body free from sulphur, and corresponding in composition to the alpha-toluylic acid amide, $C_6H_5CH_2CONH_2$: this substance is difficultly soluble in cold—more readily soluble in hot—water, readily soluble in alcohol, but very difficultly in ether; fusion-point, 154° to 155°; boiling-point, 181° to 184°.

Action of some Chlorides upon Sodium Alcoholate.—A. Geuther and F. Brockhoft.—This exhaustive monograph is divided into the following sections:—Pentachloride of phosphorus and sodium alcoholate; perchloride of ethylen and sodium alcoholate; perchloräthan and sodium alcoholate; trichlor-ethylen-chloride and sodium alcoholate; dichloräthylen-chloride and sodium alcoholate; monochloräthylen-chloride and sodium alcoholate; perchlormethan and sodium alcoholate.

Chemical Constitution of the Elementary Molecules.—Dr. H. Kolbe.

Observations on the Maxite and Leadhillite found in Sardinia.—H. Laspeyres.—This paper contains critical remarks on Bertrand's paper on this subject, published in the first number of the *Bulletin de la Societé Chimique de Paris* for this year.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, Vol. xviii., No. 3, February, 1873.

Contains no chemical papers.

Revue Scientifique de la France et de l'Etranger, No. 48, May 31, 1873, and No. 49, June 7, 1873.

These two numbers contain no chemical papers.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Mène, No. 22, April 4, 1873.

This number again contains not a single chemical paper.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxi., No. 7, June 12, 1873.

This number contains no original chemical matter.

MISCELLANEOUS.

Determination and Characteristics of Citric Acid.—Soluble citrates mixed with acetate of baryta, either hot or cold, produce a white amorphous precipitate, being citrate of barium with 14 aq. If, after precipitation, an excess of acetate of baryta be added, and the mixture heated in a water-bath, the precipitate becomes heavy and granular; it loses one-half of its water of crystallisation, and has now 7 aq. The presence of other organic acids does not interfere; the granular salt is absolutely insoluble in water, and citric acid may thus be easily determined. If the solutions are very dilute, they must be concentrated by evaporation, after additions of acetate of baryta, or the precipitate will consist of crystalline needles containing only 5 aq. Mr. J. Creuse, commenting upon M. Kammerer's paper, claims priority on the subject. He also states that M. Kammerer is in error in describing citrate of barium as insoluble in water. He contends that the citrate of baryta should be converted into sulphate before weighing, as it is very hygroscopic.

NOTES AND QUERIES.

Red-Coloured Magenta.—I have a sample of a colouring matter which appears like ordinary magenta, in a greenish golden cake soluble in water; but it dyes a brownish red tint, not at all like the salts of rosaniline. With hydrate of soda it gives a reddish precipitate or yellow if the alkali be in large excess, and a deep yellow solution. Can any of your readers inform me what this yellow solution contains, and how to utilise it? I believe the stuff is made from some residuum. —C. H.

New Ozone Generator.—Messrs. Tisley and Spiller send word that Mr. Wills stated, on commencing the reading of his paper at the meeting of the Chemical Society on the 5th of June (Chemical News, vol. xxvii., p. 292), that the generator was not his own contriving, but was manufactured by Messrs. Tisley and Spiller, and he thought it such an advance on all previous instruments as to deserve a proper notice of the Chemical Society.

Ilmenium.—Miller says that Hermann supposed he had discovered a new metal, but had since proved it to be a mixture of tantalic and columbic anhydrides. Dana ignores it, as do all the authorities I have access to. So I was not a little surprised to see the notice in the Chemical News, vol. xxvii., p. 59, of Hermann's monograph, giving atomic weight, oxides, and other particulars of ilmenium, when he was represented as admitting his former ides to be erroneous. Is Hermann the only authority for ilmenium, and are his views admitted by many chemists to be correct? If so, why has it not a place in modern chemistries?—Peter Jacobus.

Manipulation of Spongy Platinum.—In view of the fragility of the ordinary preparations of spongy platinum, as used for kindling gases, Professor Phin recommends the following capital plan:—"We have succeeded admirably with pumice-stone, which we first form into a cylinder of the proper size—say, 3-8ths of an inch in diameter—and then cut into discs about the 20th of an inch thick, by means of a fine saw. These discs are soaked for some time in a strong solution of bichloride of platinum in alcohol, and afterwards for an equal period in an alcoholic solution of sal-ammoniac. After being ignited, these discs inflame a jet of hydrogen readily, and we find that they retain their power quite as well as the more delicate forms in common use." *Handicraft.*

"Experiments with the Torsion-Rod for Determining the Mean Density of the Earth," forming vol. xiv. of the *Memoirs of the Royal Astronomical Society*. By Francis Baily, Esq., Vice-President of the Society. London. 1843.

P. 81.—"I shall now proceed to take a review of the different series, for the purpose of pointing out such of them as may appear to be less deserving of confidence than the rest, on account of certain discordances which seem to impair their accuracy. I have already noticed that slight differences occasionally arise in the mean results. . . . But it is not to cases of this kind that I am now about to allude. . . . The case, however, is somewhat different with those experiments which, during any given series or course of operations, do not exhibit so regular and uniform a system; but, on the contrary, show evident signs of some disturbing force that has hitherto escaped detection, affecting not only the march and direction of the resting point, but also the time of vibration, thus impairing the accuracy, or at least the uniformity, of the results. The most remarkable instance of this kind occurs in the 33rd series . . . ; and it is worthy of notice that in this series there are no less than three experiments, where the arc of vibration *increased* instead of being diminished: an evidence of some *extra*-disturbing force, which has baffled every effort of mine to unravel. Indeed one of the results, where this last-mentioned experiment is involved in the computation, makes the density" (of the earth) "as high as 9·150; but this rapid and enormous increase is partly assisted by a sudden change in the march of the resting point about that time, so that a variety of circumstances have here combined to produce this extraordinary result. And, astounding as this great quantity may appear, it should be noticed that one of the *single* results on the same day is as low as 4·292; so that by this counteraction the *daily* result is not so very materially affected. I am unable to throw any light on the cause of these and other discrepancies which occurred in this particular series. A similar instance, although not quite so discordant in magnitude, occurs in the 35th series. . . . . We have here also one of the experiments exhibiting an *increase* in the arc of vibration, and thus impairing the result in which its computation is involved. The last result likewise, in this series, is of very considerable magnitude, being as high as 7·425; but here also we have a *single* result on the same day as low as 4·113; so that, astounding as this quantity also may appear, yet by this counteraction the *daily* result is not sensibly affected."

P. 83.—"Other series might be adduced where the discordances between the single and daily results, although not so great as those already mentioned, evidently show that some disturbing force was in operation, which either escaped detection at the time, or against the influence of which it was found impracticable wholly to protect the apparatus. These cases have occurred mostly with the light balls, and when the torsion force . . . has been weak: and their effect has been exhibited by some irregularity in the march of the resting point, or in the time of vibration."

P. 83.—"But, even when discordances of considerable magnitude, of the kind above mentioned, do not occur, we yet find that the mean result of two several days (the mode of operation continuing the same in both cases) sometimes differ from each other by a greater quantity than might have been previously imagined . . . . which renders it manifest that we cannot always expect rigorous accuracy and uniformity in such delicate investigations, under all the various conflicting circumstances that occur in carrying on the operations."

MEETINGS FOR THE WEEK.

Monday, 23rd.—Royal Geographical, 8.30.
Wednesday, 25th.—Society of Arts, 4. Anniversary.
—— Geological, 8.
Thursday, 26th.—Royal Society Club, 6.30. Anniversary.
Friday, 27th.—Quekett Microscopical Club, 8.

TO CORRESPONDENTS.

*** Vol. XXVI. of the Chemical News, containing a copious index, is now ready, price 11s. 4d., by post, 12s., handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 2s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxvii. commenced on Jan. 3rd, and will be complete in twenty-six numbers. Reading Cases, price 1s. 6d. each, post free, may also be obtained at the Office.

Errata.—Vol. xxvii., p. 262, for $C+\frac{b}{a}$ read $\frac{b}{a}\times C$.

R.—"High Farming without Manure," by G. Ville. This author has also published several valuable works in French on agricultural chemistry.

A Subscriber.—Consult Dr. Hassall's book on the subject.

SUPPLEMENT
TO
THE CHEMICAL NEWS.
VOL. XXVII. No. 708.

ON THE
DETERMINATION OF PHOSPHORIC ACID IN ALL PRODUCTS OF AGRICULTURAL AND PHYSIOLOGICAL IMPORTANCE.

By M. JOULIE.

(Continued from p. 230).

PART II.

THE author proceeds to give an account of the application of his "citro-uranic method" to a variety of cases.

Insoluble Phosphates (consisting chiefly of phosphate of lime, accompanied by carbonate of lime, silica, oxides of iron, alumina, fluoride, chloride, and iodide of calcium, and peroxide of manganese).—Whatever may be the composition of the mineral, the analysis consists of the following operations:—Sampling, solution, precipitation of the phosphoric acid in the state of ammoniaco-magnesian phosphate, and volumetric determination of the phosphoric acid contained in the precipitate.

1. *Sampling.*—This operation, simple as it seems, requires particular attention if comparable results are aimed at. If the phosphates are ground and in bags, a scoop is plunged into about twenty of them taken at random, and the contents are emptied upon a large sheet of paper. The whole heap is then thoroughly stirred and mixed together, and two or three 8-oz. bottles are filled with the powder. This operation should be performed in presence of the seller and the buyer, or their representatives, who both put their seals on the bottles, and sign, if needful, an account of the taking of the sample. One of the bottles is sent to the laboratory where the analysis is to be conducted; the others are reserved for verifications, if needful. The chemist who receives the sample registers the date of arrival, the professed nature of the sample, and the marks on the seals. The contents are then sifted upon a large sheet of paper; if any particles do not pass the sieve, they are powdered till the whole passes through. The mass is then mixed with a spatula, and then re-passed through a coarser sieve, and returned to the bottle. If the phosphates are unground (in the rock) the difficulties are greater. To obtain a product which shall fairly represent the average composition of the whole, about a hundred spadefuls are taken from different parts of the mass, and ground up in the crushing-mill. The powder is then carefully mixed and stirred together, and the bottles filled as above.

2. *Solution.*—(*a*). The simplest method is to weigh out 5 grms. of the sample, previously finely powdered, and introduce it into a flask marked at 100 c.c. It is first moistened with a little water, and 20 c.c. of nitric acid are then added. If the substance effervesces, the acid is only added by degrees, lest the liquid should boil over. When the effervescence has subsided, the flask is placed on a sand-bath, and heated for half an hour to a temperature close upon ebullition, and agitated from time to time. The flask is then cooled, by plunging it into cold water. When it is brought to the ordinary temperature, it is filled up to the 100 c.c. mark, and shaken, after having been closed with an india-rubber stopper. The contents of the flask are then thrown upon a filter, and the filtrate received in a wide-mouthed bottle provided with a ground stopper. During filtration it is well to cover the bottle and the funnel with a bell-glass to prevent loss by evaporation. This procedure requires little time, and is followed at present in many laboratories. It is very suitable in all cases where the phosphate is entirely soluble in dilute nitric acid. In such a case no error is committed by taking one-fourth or one-half of the solution, and supposing it to represent the same fraction of the weight of material originally taken; but, if the sample contains a certain quantity of insoluble matter, an error is committed proportional in importance to the quantity of insoluble residue.

(*b*). Wherever insoluble matter is present, the following method is preferable:—5 grms. of the sample are weighed out, and introduced into a flat-bottomed beaker; 20 c.c. of water are then introduced, and the whole shaken to moisten the powder. The beaker being then covered with a watch-glass, 20 c.c. of nitric acid are added with a pipette, the watch-glass being raised on one side with the point. If the effervescence is brisk, the acid is only introduced by degrees. When all the acid is introduced, and the effervescence has nearly subsided, the beaker is set upon the sand-bath, and kept for half an hour close upon ebullition, stirring from time to time. The watch-glass is then taken off the beaker, its under-surface washed with a stream of distilled water from the washing-bottle, the liquid stirred and allowed to settle. It separates into a sediment and a clear supernatant liquid. The clear portion is decanted into a flask containing 100 c.c.; boiling water is poured upon the residue. It is again allowed to settle, and the clear portion is again decanted into the flask, and so on till the liquid is no longer acid. This result is obtained before the flask is full. The liquid is then cooled, if necessary, and filtered. If two chemists operate upon the same sample, and the one prepares his solution by the method *a*, and the other by ordinary filtration, a difference of 4 to 5 per cent may easily arise from this cause. By using the process *b*, these sources of error cease.

3. *Precipitation.*—To precipitate phosphoric acid, we take generally 5 c.c. of the liquid. If the sample has left a large amount of insoluble matter, it may be supposed poor in phosphate, and in this case 10 or even 20 c.c. may be taken. This is run into a beaker, with the addition of 10 c.c. of the citro-magnesian liquid (this liquid should contain 400, and not 500, c.c. of ammonia at 22° B.) and a large excess of ammonia. The mixture is gently stirred with a glass rod. No immediate turbidity ought to appear; should this be the case, it is a proof that the quantity of citro-magnesian liquid is insufficient, and 10 c.c. more are at once added. It is stirred again when the precipitate of the double phosphate begins to appear. To ensure complete precipitation, the liquid should stand four or five hours, and preferably overnight. The deposit forms more quickly the less heat the liquids evolve on mixture, and the greater the excess of ammonia. As heating results from the combination of ammonia with the acids of the solution, it may be readily avoided by nearly neutralising the solution of phosphate with dilute ammonia *before* adding the citro-magnesian liquid, and in adding a large excess of ammonia.

4. *Volumetric Determination of the Phosphoric Acid.*—The precipitation being complete, the liquid is filtered, the precipitate is washed with water containing 10 per cent of ammonia, re-dissolved in nitric acid of the same dilution, neutralised with ammonia, mixed with 5 c.c. of the solution of acetate of soda, and titrated with the uranium solution as already directed. The amount of moisture should always be determined, and expressed in the report of the analysis along with the phosphate.

Bone Products and Manures.—In bones and their modifications—such as boiled bones, bone-ash, animal charcoals whether fresh or exhausted, precipitated phosphates, &c.—as well as in manures, natural or artificial, the determination of phosphoric acid is effected exactly as in natural phosphates. In some cases, water and organic

matter create special difficulties, and require particular manipulations.

Animal charcoal is often so damp, and so far from homogeneous, that no certain result could be obtained with a sample of 5 grms.; in such a case, 400 to 500 grms. must be taken, and the moisture in it must be determined by drying in the water-bath. The residue is then powdered, mixed, and sifted, and 5 grms. weighed out for the determination of the phosphoric acid.

Bones and many manures contain organic matter in greater or less quantity. These substances, besides shielding the phosphates from the solvent action of the nitric acid, render the solution so glutinous that the filtrations are rendered very tedious. For this purpose, 10 to 20 grms. are placed in a platinum capsule, and calcined at very low redness. Manures containing soluble phosphoric acid should never be ignited, as a part of the acid phosphate of lime may be reduced by the action of the carbon, and thus some of the phosphorus may be volatilised. If it is necessary to incinerate such manures, they should be previously mixed with their own weight of pure lime. The loss of weight during calcination must be carefully noted. The ash is then powdered, mixed, and 5 grms. are weighed out for the determination of the phosphate.

Determination of Phosphoric Acid in the Ash of Plants, in Soils, Dung, &c.

(*a*). *Ash of Plants.*—Phosphoric acid can be determined in the ash of plants by proceeding exactly as with natural phosphates, the precaution being taken to separate the silica. 2½ grms. of the ash are weighed out, placed in a porcelain capsule, moistened with a little water, and then treated with 10 c.c. of pure nitric acid, keeping the capsule covered with a watch-glass. When the effervescence has ceased, the capsule is set on the sand-bath, and kept covered. When the liquid begins to boil, it is uncovered, the bottom of the watch-glass is washed into the capsule by means of the washing-bottle, and the liquid evaporated to dryness. The residue is heated for half an hour, let cool, moistened with a little nitric acid, to which water is added after an hour; it is then boiled gently, and filtered, or decanted into a bottle marked at 50 c.c.

(*b*). *Soils.*—The sample, having been properly taken, is treated exactly as has been directed for the ash of plants, aqua regia being used instead of nitric acid. When the silica has been separated out and washed, the filtrate and washings are mixed, and evaporated down to about 35 c.c. We add now 10 c.c. of citro-magnesian liquid, and a great excess of ammonia. The mixture is now gently stirred; if an immediate turbidity appears, more citrō-magnesian liquid is added to re-dissolve it, and the whole, after being well stirred, is set aside for twenty-four hours. At the end of this time, the phosphoric acid will be found entirely deposited in the state of double phosphate. If the soil is very poor, 20 or even 50 grms. may be taken. It may happen that, in soils produced from the decomposition of felspar, the whole of the phosphoric acid may not be extracted by aqua regia; in this case, the residue, after treatment with this solvent, is fused with a mixture of carbonates of soda and potassa, dissolved in hydrochloric acid, and, after separation of the silica, phosphoric acid may be again sought for in the liquid. It must be remembered that phosphoric acid in so insoluble a state is not of the slightest agricultural value.

(*c*). *Dung.*—500 grms. of the sample are weighed out, dried in the water-bath, and incinerated in successive portions.

(*d*). *Waters.*—Before attempting the quantitative determination of phosphoric acid in waters, a qualitative test should be applied. Add to the water a little perchloride of iron, and precipitate with ammonia. Let the precipitate stand to collect for twenty-four hours, decant off the clear liquid, re-dissolve the precipitate (which contains all the phosphoric acid) in a little hydrochloric acid, evaporate to dryness, and heat to 250° C. for thirty minutes to separate out silica. Re-dissolve in hydrochloric acid and water, filter, and add Sonnenschein's molybdic solution. If a yellow precipitate or a yellow colouration appears, the quantitative process may be begun. 10 litres of water are evaporated down to 1 litre. Hydrochloric acid is added to the still warm liquid in quantity sufficient to re-dissolve any deposit formed; then a few drops of perchloride of iron and ammonia in slight excess. All the phosphoric acid is thrown down along with the iron. The clear liquid is decanted off, the precipitate collected on a filter, washed, re-dissolved in a little hydrochloric or nitric acid, and 5 c.c. of the citro-magnesian liquid and an excess of ammonia are added to the liquid. The analysis is then completed as above directed.

Superphosphates.

The amount of phosphoric acid existing in a soluble state in a manure may be found by dividing the amount of "neutral phosphate of lime made soluble" by 2·18. The solution of a soluble phosphate is a double process. For the aqueous solution, containing the soluble phosphoric acid, we weigh out 5 grms. of the sifted sample; it is put in a glass holding about 125 grms., covered with a little distilled water, and stirred up with a glass rod flattened at the end, so as to form a thin paste; 20 c.c. of cold distilled water are then added, the whole stirred up, and left to settle. The turbid liquid is poured into a flask marked at 100 c.c., and 10 more c.c. of distilled water are put upon the sediment, until the flask is filled and the phosphoric acid is completely extracted. When this process is at an end, the last washing should no longer redden litmus-paper. The turbid solution is then filtered, under a bell-glass if needful.

The acid solution, containing, of course, the total phosphoric acid in the sample, is prepared by putting 5 grms. of the sample in a beaker, adding 5 grms. of pure nitric acid, digesting on the sand-bath, adding water, and exhausting as above. Each of these two solutions is then analysed separately as directed above. The amount of soluble phosphate deducted from the "total," as found in the acid solution, gives the quantity present in the insoluble state.

(To be continued).

FRESENIUS'S JUBILEE DAY.*

FRIDAY, May 3rd, being the twenty-fifth anniversary of the foundation of Fresenius's Laboratory, at Wiesbaden, there was, on that day, one of the most pleasing spectacles it has been my lot to witness. The large hall in which the jubilee ceremony took place was speedily filled. The greater part of the company consisted of the former and present students of Fresenius; there were also present officials of the state, as well as deputations from the various universities and scientific societies of Europe.

The ceremony was opened by a speech from Dr. Fresenius, giving an account of the erection and progress of his Laboratory. I will here endeavour to give a short account of this man's career. Dr. Remigius Fresenius was born in 1818, at Frankfort-on-the-Maine, where he passed the early years of his life. In 1840, he studied at the university of Bonn under Dr. Claud Marquart, from thence he removed, in 1841, to Liebig's Laboratory at Giessen, where he remained until the end of 1843, during which time he occupied the position of student, private assistant, and Government assistant at the above-mentioned laboratory. It was during his stay there that he published his first edition of "Chemical Qualitative Analysis."

About 1845, in answer to a call from the Nassau Government, he removed to Wiesbaden, where he commenced giving lectures on Chemistry, in the palace of the then reigning Duke of Nassau, who fully recognising

* Communicated by one of his Students.

his great abilities, was the means of helping Fresenius to erect this laboratory which has sent out so many good chemists, and established the reputation of their teacher as one of the most eminent analysts of the present day.

Fresenius's speech being ended, the President of the Duchy of Hesse Nassau, on the part of the Emperor, presented him with the Gold Medal for Science. From the Imperial Prince and Princess he received a laurel wreath, together with an autograph letter from the latter, which ran as follows :—

"On this your jubilee day, accept the hearty good wishes of myself and the Crown Prince. We take a sincere interest in this happy event, and beg you to accept, in remembrance of it, our enclosed portraits, and hope that they may find a place in that same room where you have received us so kindly. In conclusion, let me add my earnest wish, along with those that will be so loudly expressed to-day, namely, that you may be spared for many years hence both to Science and the Fatherland. "VICTORIA,

"Crown Princess."

After this, the Students' Gift was presented to Fresenius. It consisted of three elegant albums, containing the portraits of his former and present pupils. Along with these was a silver fruit dish, with a Minerva statuette on the top. The whole was supported on a marble pedestal, on which was inscribed these words:—"To Privy Councillor Professor Dr. Remigius Fresenius, from his grateful students, in remembrance of the twenty-fifth year of the foundation of the Chemical Laboratory of Wiesbaden." Then came various congratulatory addresses from this town, and also from several scientific societies of Europe.

The ceremony was closed by a speech from Professor Neubauer (who is well known in England by his book, "Analysis of the Urine.") In the afternoon there was a grand dinner given to Fresenius, where more than 200 persons sat down, when his health was drunk with enthusiasm.

In closing the account of this memorable day, I only repeat the wish of all who know this great man, in saying that it is our earnest wish that his life may yet be spared for many years to come, to reap the fruit of his arduous labours.

NOTICES OF BOOKS.

Fourth Annual Report of the State Board of Health of Massachusetts. January, 1873. Boston : Wright and Potter.

IT was once humourously remarked by a wicked German author that every Englishman was insane upon two questions—sanitary reform and the conversion of the Chinese. We are happy to find that the former craze, if craze it be, is spreading; public health is studied as diligently, and, to say the least, as wisely, in the United States as in England. Nor is this surprising; the same causes that have polluted the air and the waters of England are actively at work on the other side of the Atlantic. The compilers of the Report before us look forward to the day "when we shall reach the state of things at present existing in the manufacturing districts of England." "Some of the brooks which were but recently pure and undefiled are now polluted so that neither man nor beast will drink freely of them; and this change is insidiously taking place from year to year." The apathy still prevailing among a large and influential portion of the unscientific community is duly estimated :—"The temptation to cast into the moving waters every form of portable refuse and filth to be borne out of sight is too great to be resisted. It is felt as strongly by municipalities as by individuals. What becomes of this refuse lower down the stream is a matter of little concern. It is got rid of, at any rate." It is consolatory to find that our English corporations, and, to sound a still lower depth, our metropolitan vestries, do not monopolise all the selfishness and un-wisdom of the world. The "parochial mind," it appears, clings everywhere to its characteristic vices.

A mere glance at the contents of this Report will convince the reader of its value. We have an elaborate and exhaustive paper on "Sewerage, Sewage, the Pollution of Streams, and the Water Supply of Towns"; an analysis of evidence on "Beershops and Prohibitory Laws"; a report on the "Character of Substances used for Flavouring Articles of Food and Drink"; a paper on "Drainage for Health"; an essay on "Infant Mortality"; a chapter on the "Food of the People of Massachusetts"; a "Report on the Adulteration of Milk"; the results of a correspondence on the "Antecedents of Pulmonary Consumption"; a paper on the "Adulterations and Impurities of Food"; remarks on the "Homes of the Poor in our Cities"; a report of the "Butchers' Slaughtering and Melting Association"; and, finally, a paper on the "Health of Towns." Many of these reports treat of subjects not within our cognisance; others put forward, occasionally, views from which we most emphatically dissent, but all are the work of able, thoughtful men, and are evidently the result of research equally comprehensive and minute.

In the section on the disposal of sewage and the pollution of streams, we find the evils of neglect and the respective advantages of the "earth-closet" and the "water-closet" system very fairly stated. The ventilation of drains, the circumstances under which sewer-gases may, in spite of traps, find their way into human dwellings, the disposal of manufacturing refuse and of kitchen slops, the construction of sewers and their outlets, are all explained and described.

The feeblest portion of the Report, and, indeed, of the whole work, is the account of the various processes for the treatment of sewage adopted or proposed in England. The author, instead of depending upon his own judgment, appears to have swallowed the "Report of the Royal Rivers' Pollution Commission," "with all its blushing errors thick upon it," and without the proverbial, and, in this case, most necessary, grain of salt." To this he superadded the "Report of the British Association Committee on the Treatment and Utilisation of Sewage," and Dr. Corfield's most excellent work on the same subject. After such a course of reading, no fair estimate of the comparative merits of precipitation and irrigation could be expected. The simplicity which can still quote, in unquestioning faith, such assertion as that "The manipulations required for the extraction and drying of the A B C Company's manure are attended with a nauseous odour, and would occasion a serious nuisance if the works were situated in or near a town," and which can speak of previous sewage contamination "as a definite, determinable entity," is most refreshing. We should have given Massachusetts credit for more shrewdness. It is, however, satisfactory to find that all the analyses of waters executed for the State Board of Health have been performed by the process of Messrs. Wanklyn and Chapman, and not by that of the gentleman whom the authors characterise as "the most eminent chemical authority on the sewage question."

The following statement appears to us very questionable :—"There can be no doubt that the very extensive (almost universal) use of alcoholic drinks as an ordinary daily beverage of all classes and conditions, and of both sexes, in England, is due in part to the fact that water of unquestionable purity is so very difficult to obtain." We see no evidence that the relative consumption of alcoholic liquids is smaller in towns supplied with pure water, such as Manchester, Glasgow, or Halifax, than it is in London.

If the people of Massachusetts are about to take the prudent step of excluding polluting matter from their streams and lakes, we would beg to suggest the following

standard :—That nothing should be allowed to flow into a river containing a greater amount of putrescible impurity than does the water of the river itself. They would do well, also, in legislating concerning manufacturing refuse, to exclude copper, lead, chrome, &c., as stringently as arsenic, and not place these poisonous metals on the same footing as the comparatively innocuous iron and aluminium. Whilst unable to afford at present more space to the examination of this work, we must pronounce it a storehouse of important information, and strongly recommend its perusal to all sanitary reformers.

Manual of Chemical Analysis as applied to the Examination of Medicinal Chemicals. By F. HOFFMANN, Ph.D. New York : D. Appleton and Co., Broadway.

GENERAL treatises on chemical analysis, however ably compiled, though still necessary, are no longer sufficient for the wants of the age. Each class of chemical investigators requires a separate and especial code of instructions. The agricultural chemist, the colourist, and the metallurgist have for some time enjoyed the advantage of works of this nature. It is therefore with great satisfaction that we note the appearance of the present manual especially adapted to the requirements of the pharmaceutical chemist and the manufacturer of medicinal chemicals.

The first part of the work gives an account of the needful reagents and apparatus to be employed, with a brief systematic course of qualitative analysis and of volumetric operations. The second part enumerates the chief pharmaceutical chemicals in alphabetical order, pointing out the impurities and sophistications to which each is liable, and the most approved methods for ascertaining its quality. As a rule the processes recommended have been judiciously and carefully selected. The instructions for distinguishing the organic bases from each other, and for determining the amount of the more important,—such as morphia and quinine contained in commercial samples of the raw materials,—are full and trustworthy.

Some of the illustrations, we cannot help saying, are most needlessly repeated. Some of the synonyms of every substance are given, but this useful feature of the book might, with advantage, have been made more complete.

The work concludes with tables for the reciprocal conversion of metric and troy weights, and with a very elaborate index. We hope that its circulation, on both sides of the Atlantic, may facilitate the detection both of adulterations and of the impurities resulting from negligence, and hence tend to make these evils less plentiful.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture or composition of fuel. Langley Banks, 127, Campbell Street, Kingston-upon-Hull. November 12, 1872.—No. 3362. The invention relates to the combination of the following matters:—1st. The refuse which accumulates round the mouths of coal-pits. 2nd. Small coal. 3rd. Turf, peat, or such like matter. 4th. Mineral pitch. 5th. Coal-tar. 6th. The scum or refuse from cotton seed after obtaining oil-cake therefrom. The coal-tar and the mineral pitch are prepared by being mixed whilst hot and after being boiled in the ordinary manner in equal proportions. The two are then run together; before use they are re-boiled and mixed with the other ingredients before named. The whole are then compressed together by steam-power or otherwise, and the composition is then ready for use.

Certain improvements in the treatment of night-soil and other refuse matter. Gustav Alsing, civil engineer, 3, Bank Place, Preston, Lancashire. November 15, 1872.—No. 3412. For the purpose of fixing the ammonia contained in night-soil, sewage, or other refuse matter used as manure, or otherwise, and at the same time solidifying the said night-soil, sewage, or other refuse matter so as to render it in a convenient state for transport and immediate use I mix it with a proportionate quantity of sulphate of lime, commonly called gypsum or plaster-of-paris.

Improvements in the manufacture of steel and malleable iron, and in furnaces therefor. Friedrich Hahn, professor of chemistry, Berlin, Germany. November 16, 1872.—No. 3417. In manufacturing steel and malleable iron according to my improved process, I first melt the iron ore or pig-iron and cause the molten cast-iron to descend through a chamber or passage which is supplied with heated air by a suitable blast, and in passing through the heated air the crude metal is fully exposed thereto, and being acted upon by the oxygen in the same is thereby decarburised and also freed from the various impurities usually existing in iron ore or pig-iron.

A new or improved varnish. Thomas Bagley, varnish maker, Birmingham. November 16, 1872.—No. 3421. This new or improved varnish has the following composition :—40 lbs. of damar gum, 10 lbs. of copal gum, 3 lbs. of kowrie gum, 84 lbs. of common resin, 20 lbs. of superfine resin, 16 lbs. of chloride of sodium, 51 lbs. of oil of turpentine, 51 lbs. of resin spirit, 570 lbs. of benzoline. In mixing and incorporating the materials the gums and the chloride of sodium are first melted and the resin afterwards added thereto. The mass having cooled to about 110° F., the resin spirit is added, and the temperature having been further reduced, the turpentine is added, and the temperature having been still further reduced, the benzoline is added, the several ingredients being thoroughly incorporated together. The varnish is then strained to complete its manufacture. This varnish hardens very rapidly, and is especially useful for varnishing metallic articles to prevent rusting or corrosion, but may also be applied to non-metallic articles, and to various other purposes .

Improvements in treating fatty materials in combination with various kinds of pitch, alkalies, and oil, also in the treatment of animal, vegetable, and mineral oils for lubricating purposes. Robert Hornby, manufacturer, Marchmont Street, Middlesex. November 19, 1872.—No. 3445. The novelty of my invention consists in the amalgamation of the ingredients for lubricating purposes, and in the use of steatine or other earthy substances as a lubricant for railway-carriage and other axles.

An improved apparatus for and method of treating wood and other similar substances for the manufacture of half-stuff and paper. Carl Dietrich Julius Seitz, analytical chemist, Edinburgh. November 19, 1872.—No. 3446. Wood is boiled in a vessel through which a constant circulation of heated caustic soda lyes is effected by a pump placed between and connected to the wood-boiler and a heater.

Improvements in the preparation of autographic tracing-paper and in the fluid employed in connection with the same. Charles Ladislas Siecinoski, 1, Taplow Cottages, Balham, Surrey. November 19, 1872. —No. 3451. The invention is based on the principle of the reaction of chromates on gelatine, gums, and albumen, and consists in the preparation of an autographic tracing-paper and an improved ink for writing or drawing on the same in order that the said writing or design may be transferred immediately or at any subsequent period.

An improved method for purifying and amalgamating gum resins, including kauri gum. Alfred Morgan, merchant, 258, South Lambeth Road, Surrey. November 20, 1872.—No. 3460. Pulverising the gum in order to extract from it the foreign substances held in combination with it. The use of chloride of lime in solution for separating from the gum the woody particles and foreign substances usually found in it. The use of moist or wet heat and pressure for amalgamating the powdered or small gum preparatory to use.

Improvements in deodorising and purifying sewage and other excrementitious matters and in obtaining certain useful products therefrom. Edwin Hills, manufacturing chemist, Warsash, Southampton, and Benjamin Biggs, merchant, 3, Laurence Pountney Hill, London. November 20, 1872.—No. 3464. This invention consists in treating sewage, night-soil, and other excrementitious matters so as to deodorise and purify them and to obtain ammonia and sulphur as residual products. According to one process the matters to be treated are mixed with lime in an air-tight tank. Air is then forced through the said matters, thereby precipitating the solid parts. The said air is then conveyed to a second tank carrying with it sulphuretted hydrogen and ammoniacal gases. This second tank contains sulphurous acid, through which the aforesaid gases are passed, and sulphite of ammonia and sulphur are thus obtained. Or the aforesaid gases may be passed through sulphuric or muriatic acid in the second tank to fix the ammonia and the sulphuretted hydrogen, and other uncondensed gases are afterwards passed through sulphurous acid or through hydrated oxide of iron contained in a third tank to decompose the sulphurous hydrogen and obtain sulphur. The sewage precipitate in the first tank may be used as a manure. According to another process the matters to be treated are placed in an air-tight tank and sulphurous acid forced through them to precipitate the solid parts and fix the ammonia and decompose the sulphuretted hydrogen and obtain sulphur therefrom. The sewage precipitate or sludge thus obtained may either be dried and used as a manure or it may be burnt so as to cause it to give off its sulphur in the form of sulphurous acid gas or be otherwise utilised.

Improvements in the manufacture of steel. Peter Jensen, engineer and patent agent, 89, Chancery Lane, Middlesex. (A communication from Thomas Brooks, Minerva, Ohio, U.S.A.). November 21, 1872.—No. 3477. According to one arrangement the ingredients are by preference taken in the following proportions, viz.:—74 lbs. of bar iron, 14 ozs. of tungsten, 8 ozs. of charcoal, 3 ozs. of manganese, 8 ozs. of fluor-spar, or chlorophane, and are treated as usual in a smelting-pot. When a finer quality of tool welding steel is required, 2½ ozs. of calcium tungstate is substituted for the tungsten. In producing a "file steel" he uses by preference about 74 lbs. of "Bessemer" scrap or rail bar, 1½ lbs. of cast-iron, or 2 lbs. of fluor-spar, or chlorophane, ½ oz. of manganese, 1½ ozs. of charcoal, 1 oz. of bismuth, and the same is treated in a smelting-furnace. In some cases 74 lbs. of wrought bar-iron, 14 ozs. of tungsten, 14 ozs. of spiegeleisen, 8 ozs. of charcoal, ½ oz. of black oxide of manganese are employed and treated as usual in a crucible. Steel thus produced will weld without the usual chemicals employed for that purpose, will make tools capable of receiving clean sharp edges, and be perfectly malleable and tough. In the above processes the inventor prefers to use Swedish roll bar of the K B brand.

THE CHEMICAL NEWS.

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ON THE REDUCTION OF PURE ANHYDROUS SESQUIOXIDE OF IRON WITH PURE CARBON IN VACUO.

By JOHN PARRY,
Ebbw Vale Iron Works, Newport, Mon.

Beyond the mere fact that carbon, in contact with the oxide of iron at a red heat and upwards, reduces the latter to the metallic state, we have little or no information as to the part which carbon takes in the reduction of oxide of iron. It has been shown by the author's previous experiments, and by others, that carbon most carefully prepared by the ordinary methods still contained volatile matter capable of evolving gas under suitable conditions, *i.e.*, on heating *in vacuo*, or on being brought in contact at a red heat with oxides; hydrogen combining with oxygen to form water, and the remaining gases form other gaseous compounds with oxygen, the solid carbon being also taken up by the oxide in contact with it. Taking this view of the matter, it may be said the decomposition of sesquioxide of iron by the direct action of carbon only has never yet been achieved.

It occurred to the author that this might be done *in vacuo*, taking suitable precautions to secure sesquioxide of iron and carbon free from gas of any kind.

The mercury air-pump offered a ready means of doing this; and accordingly pure sesquioxide of iron and carbon were made by Mr. E. H. Morton, F.C.S., as follows:—

Pure sesquioxide of iron was prepared from pure oxalate of iron; the dried salt was heated in a combustion-tube, in a current of purified hydrogen, until complete reduction took place. The metallic iron obtained had a steel-grey colour. It was dissolved in hydrochloric acid, oxidised, and precipitated by ammonia. The precipitate was well washed a great number of times with boiling water, dried at 100°, then ignited. This was found to be quite pure, with the exception of a trace of sulphur.

Preparation of Carbon free from Volatile Matter.—This was made from white sugar, first heated until all evolution of gas had ceased, then in the full heat of a gas blowpipe, next fusing heat of iron, and lastly *in vacuo*, and kept in well-stoppered bottles.

The object being—(1) To ascertain, experimentally, that on heating carbon in contact with sesquioxide of iron, the latter was reduced; (2) the temperature at which reducing action commenced; (3) the rate of reduction at known temperatures: (4) quantity and kind of gas evolved at various degrees of heat. The author proceeded as follows:—

Expt. 1.—1 grm. of sesquioxide of iron mixed with 0·25 grm. of carbon was placed in a glass tube closed at one end, the other being drawn out and attached to the pump with water-joint, as shown in Frankland and Armstrong's memoir (*Chemical Journal*, vol. vi., p. 90). A vacuum being first formed in the cold, the part of the tube containing the mixed sesquioxide of iron and carbon was placed in a vessel of water, which was then heated to boiling; no gas was evolved, showing that the temperature was insufficient. The tube was next placed in a bath of fused lead, gas was slowly evolved, and in 7·30 hours 3·3 c.c. of gas was collected (B 760 temp. O deg.), which contained 87·2 per cent carbonic acid, equal (the number of c.c. of oxygen in 1 grm. Fe_2O_3 being 209·834 c.c.) 1½ per cent nearly oxygen evolved.

Expt. 2.—The amount of carbon required for the conversion of the oxygen contained in 1 grm. of sesquioxide of iron into CO_2 being 0·1146 grm., 1 grm. of sesquioxide of iron was mixed with 0·13 grm. of carbon, the carbon and oxide were well mixed with a spatula on a sheet of glazed paper, and transferred to a porcelain tube, the mixture being about the centre. The posterior end of the tube was closed with a well-fitting dry cork coated with melted sealing-wax, and thereby rendered impervious to air. The other end of the tube was connected with the pump by means of a pierced, well-fitting, india-rubber cork and glass tube, the cork being coated with a thick varnish. Thus arranged, on pumping, the vacuum was found to be perfect, the whole being kept *in vacuo* for twelve hours previous to heating. For heating, a small gas blast-furnace was fitted up, in which the tube was laid, the part containing the mixed carbon and sesquioxide of iron being placed so that the blast gas flame should play exactly upon the part containing the mixture.* By regulating the gas and air any desired temperature could be obtained and maintained; the temperature being estimated by putting small rods of different metals in the gas flame, regulating the supply of gas and air so as to just fuse the metals in the flame, it being assumed that the tube and its contents in the same flame had an equal temperature.

At a heat rather above the fusing-point of zinc, but *below* that of brass, 53·52 c.c. of gas were evolved in 7 hours 10 minutes, containing 37·15 c.c. CO_2 16·37 CO = 45·335 oxygen taken up from 1 grm. of sesquioxide of iron, or 21·605 per cent. At the end of 7 hours and 10 minutes the gas had all but ceased coming off, and only a few bubbles were collected on further heating for three hours.

The heat was now raised to *bare* fusing of brass. Gas was evolved, as nearly as could be estimated, at the rate of 5 c.c. per hour for 1 hour 15 minutes.

The heat again raised, brass readily *fused*, but not copper. Gas came off at nearly three times the previous rate; at the end of two hours it had nearly ceased. The heat was continued for one hour longer, but very little gas was evolved.

Heat was now raised to nearly fusing-point of copper. At this temperature gas was rapidly evolved, and for the first 3 hours and 25 minutes came off without the aid of the pump; after this the pump was required to collect the gas.

Total gas in ten hours, temperature rising from bare fusion of brass to *bare* fusing of copper, 51·273 c.c. CO_2 130·547 CO = 116·546 c.c. oxygen, taken up from Fe_2O_3.

The total number of c.c. gas evolved in 17 hours 10 minutes was 235·34, of which 88·423 was CO_2, and 146·917 CO, equal 161·881 c.c. oxygen from the sesquioxide of iron, leaving only 47·953 oxygen still in combination.

These experiments show—first, that at low temperatures the reducing action of carbon is slow, also that such action is not long continued; after a certain time it practically ceases altogether; but it is also clear that at low temperatures an economy of carbon is effected, the temperature not being sufficient to convert the carbonic acid first formed into carbonic oxide. Nevertheless, it is shown that, even at low temperatures a considerable amount of oxygen is liberated; thus, in 7 hours 10 minutes, nearly 22 per cent of the total quantity was evolved, and when it is considered that in reduction operations on the large scale this may be considered a comparatively short time, the reducing action of carbon on sesquioxide of iron, even at low temperatures, deserves consideration. The after trials, at temperatures below the fusing-point of cast-iron, also show that the reduction of sesquioxide of iron by solid carbon is *rapidly* effected. Altogether, the time, 17 hours 10 minutes, required for the evolution of 75¼ per cent oxygen is less than the time usually taken by iron ore in its descent from the top to the bottom of the blast-furnace; but it must be remembered that the *whole* of the *ore* cannot be said to be in contact with carbon in the blast-furnace, and consequently this only applies in a modified degree to the blast-furnace.

* The end of the tube kept cool with a small stream of water constantly running.

The author, however, wishes this to be considered as only a preliminary paper. It is intended to carry out these experiments *in vacuo* in a more complete manner, and the exact effect due to temperature will be thoroughly tested by heating weighed sesquioxide of iron and carbon in fixed baths of the metals and their alloys, from the fusing-point of zinc to that of cast-iron, taking the time required until action ceases, the amount and composition of the gases evolved, from which the amount of oxygen taken up can be readily calculated.

It is also intended to carry out a similar series of experiments with various kinds of iron ore.

Next, to test the action of carbon on Fe_2O_3 in—(1) an atmosphere of CO_2; (2) of CO; notably the latter, in order that the results may be compared with those *in vacuo*.—*Journal of the Iron and Steel Institute.*

ON THE

DETERMINATION OF PHOSPHORIC ACID IN ALL PRODUCTS OF AGRICULTURAL AND PHYSIOLOGICAL IMPORTANCE.

By M. JOULIE.

(Concluded from p. 310).

PART III.

To be assimilable, phosphates must be soluble in the water of the soil. But, except the acid phosphate of lime, all calcic phosphates are insoluble, or nearly so, in pure water. Even the acid phosphate is soon converted into a neutral salt by the lime in the soil. But the water in the soil is not pure, but charged with carbonic acid, and is thus able to dissolve the neutral, and even the tribasic, phosphate of lime when recently precipitated. The water in soils contains, further, salts which all, more or less, promote the solution of phosphate of lime. The humus contained in the dark coloured soil of heaths and woodlands attacks phosphates energetically; this is in part due to the presence of acetic acid in humoid matter, as proved by Déhérain. The assimilability of a phosphate depends on the greater or less ease with which it is attacked by the solvents just mentioned, and also on the class of solvents which it finds in any given soil. Thus, Ardennes phosphate, well ground, is assimilable with ease in recently-cleared woodlands, but useless in chalky soils where humus is wanting; hence, the value of a phosphate cannot be stated without an exact knowledge of the soil where it is to be employed. Agricultural practice recognises in recent bones more general applicability than in fossil phosphates; hence, they bring a higher price per unit. Spanish apatite in fine powder, though far richer in phosphoric acid than the phosphatic fossils of the Ardennes, is less efficacious; hence, the mere percentage of phosphates cannot determine the value of a phosphatic mineral. Hence, the rich mineral phosphates are now almost exclusively devoted to the manufacture of superphosphate; the fossil phosphates of the Ardennes are used upon newly-cleared woodlands; whilst recent bones are applied with success to all soils. These differences depend on the state of aggregation. If phosphates are treated with an energetic solvent, like hydrochloric or nitric acid, all dissolve readily. With sulphuric acid there is a marked difference in their behaviour, whilst acetic acid separates them into two great classes. Apatites, phosphorites, and coprolites yield to this acid merely a little carbonate of lime and a trace of phosphate. Bone-products are attacked, though much less completely, if they have been ignited. Pure tribasic phosphate, recently precipitated and air-dried, dissolves almost entirely, but, if previously calcined, only about one-half is soluble. The author determined the most favourable conditions for the action of each reagent upon phosphates, and then allowed them to act under these conditions upon a series of normal phosphates which had been previously carefully analysed. The analysis of the products of the reaction enabled him to find precisely the degree in which each had been attacked. The two reagents selected were oxalate of ammonia and acetic acid. The phosphate most easily acted on, with the exception of the soluble acid phosphate, is the neutral salt obtained by the double decomposition of chloride of calcium and phosphate of soda in dilute solutions; it contains—

$$\left.\begin{matrix}2CaO\\HO\end{matrix}\right\} PO_5 + 4HO.$$

It does not lose its crystalline water below 115°, and can therefore be dried at 100° without decomposition. This phosphate was taken as a standard of assimilability. By boiling oxalate of ammonia it is almost entirely converted into oxalate of lime and phosphate of ammonia. The following proportions were most favourable:—

Powdered and sifted phosphate ..	0·5 grm.
Crystalline oxalate of ammonia ..	2·0 grms.
Distilled water	150 c.c.

The whole was placed in a flask marked at 200 c.c., and boiled gently for two hours on the sand-bath, cooled, and filled up with distilled water to 200 c.c. The amount of phosphoric acid dissolved was found to be 96·85 per cent of the entire proportion present. The acetic acid used was commercial pyroligneous acid, containing 428·72 grms. of $C_4H_4O_4$ per litre. Its action upon phosphate of lime was rather hindered by heat; hence, the experiments were made at ordinary temperatures. Half a gramme of the phosphate to be examined, powdered and sifted, was placed in a flask, mixed with a measured volume of the pyroligneous acid, and shaken up. The mixture is let stand for four or five hours, with occasional shaking, and filtered. A known volume of the clear liquid is mixed with excess of ammonia. If no precipitate is formed, it is a proof that no phosphate has been dissolved; if a precipitate is formed, it is re-dissolved. To dissolve completely half a gramme of the neutral phosphate, 50 c.c. of the acid are required. All the other phosphates were treated with the same proportion and under the same conditions. A numerous series of phosphates were then submitted to these reagents. No. 1 was the neutral phosphate above mentioned. No. 2 was a precipitate formed by adding excess of ammonia to the hydrochloric solution of bone-ash, washing with much water, and drying in the air. It contained—

Phosphoric acid	24·00
Lime	28·80
Loss on ignition	47·20
	100·00

In pure tribasic phosphate, the lime would be only 28·32; the precipitate contains, therefore, lime in excess, as always happens when phosphate of lime is thrown down by ammonia in presence of excess of lime salts. The loss on ignition is water. No. 3 was a tricalcic phosphate obtained under different conditions. Bone-ash was dissolved in hydrochloric acid, precipitated with ammonia, washed by decantation, re-dissolved in acetic acid, boiled, and partially evaporated. An abundant deposit was formed, which was washed in much water, dried at 100°, and powdered. It contained—

Phosphoric acid	40·31
Lime	46·40
Loss on ignition	11·60
Chlorine..	1·22
Loss	0·47
	100·00

No. 4 is the same after prolonged ignition, and containing 44·364 of phosphoric acid. These phosphates are all unequally attacked by oxalate of ammonia, and all less than the neutral phosphate. The results were—

Designation.	Phosphoric Acid. In 100 kilos. of sample.	Dissolved for 100 parts of Phosphate experimented on.	Dissolved for 100 parts of Phosphoric Acid present.
1. Neutral phosphate ..	39·04	37·77	96·85
2. Tricalcic phosphate, precipitated in the cold, and air-dried..	24·00	24·80	90·83
3. Tricalcic phosphate, precipitated from a boiling acetic solution	40·31	28·18	69·90
4. Tricalcic phosphate calcined	44·36	23·94	53·96

Acetic acid acted less energetically, but in the same relative order.

Nos. 5 and 6 are phosphates from two manufactories of gelatine, obtained by dissolving in dilute hydrochloric acid, and precipitating with lime. No. 7 is a solution of a mineral phosphate precipitated in the same manner. The results were—

	Percentage of Phosphoric Acid in the sample.	Oxalate of Ammonia. Phosphoric Acid Dissolved for 100 parts of Phosphate present.	Oxalate of Ammonia. Phosphoric Acid Dissolved for 100 parts of Phosphoric Acid present.	Acetic Acid. Phosphoric Acid Dissolved for 100 parts of Phosphate present.	Acetic Acid. Phosphoric Acid Dissolved for 100 parts of Phosphoric Acid present.
5.	36·26	34·12	94·09	26·23	72·35
6.	32·00	26·35	82·46	25·67	80·22
7.	37·05	21·84	58·98	12·95	34·95

The order of solubility of Nos. 5 and 6 is here not the same for the two reagents, whilst No. 7 shows an unexpected inferiority. Careful experiments with mineral phosphates precipitated in the laboratory, proved that this result was due, not to the origin of No. 7, but to its mode of preparation: hence, the manufacturer of precipitated phosphates can always check the value of his methods by ascertaining the solubility of the products in oxalate of ammonia and in acetic acid. Powdered bones freed from gelatine, animal charcoal, and bone-ash were next examined. Their solubility was likewise found to diminish in proportion to the elevation and duration of the temperature to which they had been submitted.

Name of Sample.	Percentage of Phosphoric Acid.	Oxalate of Ammonia. Phosphoric Acid Dissolved for 100 parts of Phosphate present.	Oxalate of Ammonia. Phosphoric Acid Dissolved for 100 parts of Phosphoric Acid present.	Acetic Acid. Phosphoric Acid Dissolved for 100 parts of Phosphate present.	Acetic Acid. Phosphoric Acid Dissolved for 100 parts of Phosphoric Acid present.
8. Powdered bones free from gelatine	30·00	20·38	67·93	24·00	80·00
9. Animal charcoal	29·40	12·85	43·70	16·60	56·53
10. Bone-ash	34·56	11·62	34·98	8·37	24·21

Guanos.

Name of Sample.	Percentage of Phosphoric Acid.	Oxalate of Ammonia. Phosphoric Acid Dissolved for 100 parts of Phosphate present.	Oxalate of Ammonia. Phosphoric Acid Dissolved for 100 parts of Phosphoric Acid present.	Acetic Acid. Phosphoric Acid Dissolved for 100 parts of Phosphate present.	Acetic Acid. Phosphoric Acid Dissolved for 100 parts of Phosphoric Acid present.
11. Guano from Guanape..	20·27	17·56	86·66	16·89	83·33
12. Bolivian ..	27·32	12·38	45·34	14·64	53·58

Hence it appears that, if the Guanape guano is poorer in phosphates than the Bolivian, it has the advantage in solubility and assimilability.

Phosphates of the Green Sand.

Name of Sample.	Percentage of Phosphoric Acid in the sample.	Oxalate of Ammonia. Phosphoric Acid Dissolved for 100 parts of Phosphate present.	Oxalate of Ammonia. Phosphoric Acid Dissolved for 100 parts of Phosphoric Acid present.
13. Phosphate from the Ardennes (rich) ..	23·61	8·09	34·26
14. Phosphate from the Ardennes (poor) ..	18·88	5·74	30·40
15. Russian (green and poor)	14·86	4·50	30·27

On these phosphates, acetic acid has no action. Oxalate of ammonia places them between animal charcoal and bone-ash, the exact rank which agricultural practice assigns them.

Phosphates from the Departments of Lot, Aveyron, Tarn, and Tarn and Garonne.

Name of Sample.	Percentage of Phosphoric Acid.	Oxalate of Ammonia. Phosphoric Acid Dissolved for 100 parts of Phosphate present.	Oxalate of Ammonia. Phosphoric Acid Dissolved for 100 parts of Phosphoric Acid present.	Acetic Acid. Phosphoric Acid Dissolved for 100 parts of Phosphate present.	Acetic Acid. Phosphoric Acid Dissolved for 100 parts of Phosphoric Acid present.
16. Agatised phosphate; hard; powder pale yellow	34·50	8·72	24·60	9·55	27·60
17. Concrete; soft; powder deep yellow	16·80	5·70	33·93	5·74	34·17
18. Similar sample from another mine	20·70	6·40	30·91	5·85	28·76
19. Concrete; white and soft; powder white	31·80	6·75	21·24	6·53	20·53
20. Agatised; blue and hard; powder grey..	35·60	7·08	19·88	6·75	18·96
21. Concrete; brown and soft; powder brown	21·60	3·38	15·62	2·47	11·46

These phosphates belong to the same formation, but they are mixed with variable quantities of foreign matter—such as carbonate of lime, ferruginous clay, and oxide of manganese—which modify their state of aggregation, and consequently their solubility. They are distinguished from the nodules of the Ardennes by their greater solubility in acetic acid. They are only fit for conversion into superphosphate.

	Name of Sample.	Percentage of Phosphoric Acid.	Oxalate of Ammonia.		Acetic Acid.	
			Phosphoric Acid Dissolved for 100 parts of Phosphate present.	Phosphoric Acid Dissolved for 100 parts of Phosphoric Acid present.	Phosphoric Acid Dissolved for 100 parts of Phosphate present.	Phosphoric Acid Dissolved for 100 parts of Phosphoric Acid present.
22.	Phosphate of Ain (Bellegarde)	16·51	4·38	26·52	0·00	0·00
23.	Rhone Valley (fossils of the Gault)	23·00	5·88	25·56	0·00	0·00
24.	Phosphorite (Nassau)	31·74	7·10	22·40	0·00	0·00
25.	Coprolite (Cambridge)	23·80	5·20	21·84	2·25	9·46
26.	Navassa phosphate	30·62	4·95	16·47	4·73	15·44
27.	Nivernais phosphate	22·20	3·15	14·19	1·35	6·08
28.	Apatite (Caceres, Spain) ..	31·14	4·10	13·16	0·00	0·00
29.	Apatite (Canada)	32·01	trace	trace	0·00	0·00

The phosphates of Bellegarde, of the Rhone, and Nassau, approach the type of the Ardennes nodules by their solubility in oxalate of ammonia and their insolubility in acetic acid. That of Navassa resembles the phosphates of the Garonne. Cambridge coprolite and Nivernais phosphate belong to the type of the bone products.

Oxalate of ammonia enables us to class phosphates in a series closely approximating to that of their relative assimilability. The action of acetic acid, less powerful and general, enables us to seize some distinctions which the oxalate fails to indicate.

It is evident that the agricultural value of phosphates for use in an undissolved state depends more on their solubility, and consequent assimilability, than on their percentage of phosphoric acid.

CONVERSION OF THE SULPHATES OF THE ALKALIES INTO THE CARBONATES, TARTRATES, &c., IN THE MOIST WAY.

By J. LAWRENCE SMITH.

Having had occasion more than once to convert small quantities of the sulphates of the alkalies into carbonates, I have for several years employed a process that has been found both certain and convenient: in some recent investigations it has been used, and as it has never been described it may not be unimportant to explain the nature of the process and its results. The agent used to produce the conversion is carbonate of baryta, made by precipitation: where precise results are required the carbonate should be prepared by carbonate of ammonia. The manner of producing the decomposition is as follows:—Dissolve the sulphate of potash in water, using about 20 or 30 grms. of water to every gramme of the sulphate, and saturate the solution with carbonic acid by passing a current of carbonic acid into it; or, what is better, dissolve in the beginning the sulphate in water already saturated with carbonic acid; now add to this solution precipitated carbonate of baryta, in the proportion of about 1½ of the carbonate to 1 part of the sulphate. It is always best, in adding the carbonate, to rub it up in a mortar with a little water, so as to form a thick cream, for by so doing it mixes well in the solution.

This operation is performed in a bottle that can be well corked with a cork or gum stopper; now agitate the bottle frequently, or, what is still better, attach it to a piece of machinery that will agitate the bottle. Many laboratories have such, and it is a very useful one in many experiments. In a longer or shorter space of time, the decomposition will be completed, pour the solution into a capsule and heat to the boiling-point; the solution will then contain only carbonate of potash.

The reaction is readily understood. The carbonic acid in the water dissolves a little carbonate of baryta, which is immediately re-precipitated in the form of sulphate, carrying down a portion of the sulphuric acid of the soluble sulphate, and replacing the same with carbonic acid; this is rapidly repeated through the agency of the free carbonic acid, until the decomposition of the sulphate is complete.

Among many experimental results, I will give the following;—Five grms. of the sulphate of potash, dissolved in carbonic acid water, to which was added 7 grms. of precipitated carbonate of baryta, after four and a half hours' shaking (being attached to a suitable piece of machinery), on testing showed not a trace of sulphuric acid, care being taken to wipe the neck of the bottle near the end of the stopper before pouring out the liquid.

Other experiments, varying in proportion, gave similar results. I tried to substitute the natural for the precipitated carbonate of baryta, but with very unsatisfactory results.

Directions for the Conversion of the Alkaline Sulphates into Tartrates, Oxalates, &c.—As the tartrate and oxalates of baryta are but very slightly soluble in water, we cannot form the alkaline salts of these acids by direct double decomposition of the sulphates of the alkalies and the tartrate, &c., of baryta, as in forming the alkaline chlorides from the sulphates; but it is easily done by the following indirect process:—

Add to the alkaline sulphates in solution, in a porcelain capsule, carbonate of baryta rubbed up into a thick cream, in the proportion of about 5 of the sulphate to 7 of the carbonate of baryta; heat the mass, and add, little by little, the requisite quantity of tartaric or oxalic acid. Solution of the baryta and precipitation of the sulphuric acid take place rapidly, and the decomposition is soon completed.

I have used this process of forming the bitartrates in the process of separating potassium, rubidium, and cæsium, that were in the form of sulphates.

The Carbonates of the Alkalies can also be formed by first forming these organic salts from the sulphates, evaporating the solution to dryness, and burning the residue; in fact, I frequently find it more convenient to convert the sulphates of the alkalies into the carbonates by this last instead of the first process. And, finally, I would remark that, where magnesia is present with the sulphates, this is also separated from the alkalies.—*American Chemist.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 19, 1873.

Dr. Odling, F.R.S., President, in the Chair.

When the minutes of the preceding meeting had been confirmed, and the donations made to the Society announced, the name of John Douglas, Esq., was read for the first time. For the third time, those of Messrs. Walter Odling, Archibald Kitchin, James Emerson Reynolds, and Robert Wild, who were then balloted for and duly elected.

The first paper, by J. H. Gladstone, F.R.S., and

A. TRIBE, entitled "*Researches on the Action of the Copper-Zinc Couple on Organic Bodies*" (III. "On Normal and Isopropyl Iodides"), was read by Dr. Gladstone. The action of isopropyl iodide on the dry couple at 50° commences after a few minutes, gases are evolved, and the liquid residue in the retort, when strongly heated over a flame, evolves more gas, and at the same time a small quantity of a liquid distils over, apparently containing zinc-isopropyl. As it had been found that more zinc-amyl was produced from the corresponding amyl compound when the contents of the flask were distilled *in vacuo*, the same method was adopted with the isopropyl iodide; and in this case, also, the product obtained was considerably larger. Careful examination and analyses of the gases evolved showed that they consist of nearly equal volumes of propylene, C_3H_6, and hydride of propyl, C_3H_8. The two reactions, $Zn+2C_3H_7I=ZnI_2+C_3H_6+C_3H_8$ and $2Zn+2C_3H_7I = ZnI_2+Zn(C_3H_7)_2$, go on simultaneously at 50°, and when heated to 130° most of the $Zn(C_3H_7)_2$ splits up into $Zn+C_3H_6+C_3H_8$. As was to be expected, the action of the couple on the iodide in the presence of water or alcohol gave propyl-hydride, C_3H_8, the action being more rapid with the alcohol. Experiments similar to the above were also made with zinc-foil and granulated zinc, but in both cases the action was very much more sluggish, and required a higher temperature than when the couple was employed. In the investigations with the normal propyl-iodide it was found necessary to heat the iodide with the dry couple to 80° before any action took place; at 109° the action was much more rapid, and but little gas was evolved. On strongly heating the product in a current of carbonic anhydride, a large quantity of zinc-propyl passed over, which, on rectification, distilled almost entirely between 146° and 148°. When pure, it is a colourless mobile liquid, slightly denser than water, and boiling at about 146°; exposed to the air, it takes fire spontaneously and burns with a white flame. The action of the couple on the normal iodide in the presence of water or alcohol yields propyl-hydride, but the action is much less energetic than in the case of the isopropyl compound. These results entirely agree with the evidence already existing of the comparative instability of the isopropyl compounds. The authors conclude with some additional notes on the couple, describing the most advantageous way of preparing it.

The PRESIDENT, having thanked the authors for their valuable communication, enquired whether the copper took any part in the reaction, or whether alloys had been tried, to which Mr. Tribe replied that the copper had no direct action, and that brass had been tried by Dr. E. T. Thorpe, but was without effect.

The next paper, "*On the Influence of Pressure on Fermentation*" (Part II. "The Influence of Reduced Atmospheric Pressure on Alcoholic Fermentation"), was read by the author, Mr. HORACE T. BROWN, who, after referring to his former paper, proceeded to describe the methods employed, and the precautions necessary to ensure concordant results in ascertaining the amount of alcohol and carbonic anhydride produced by the fermentation of malt-wort and solutions of cane sugar under diminished pressure. He prefers determining the carbonic anhydride by the loss of weight, or by absorption by potash and soda-lime, as being more accurate than the measurement of the gas evolved. A consideration of the tabulated results obtained in this way shows that diminished pressure retards the progress of the alcoholic fermentation in a remarkable way, although there does not seem to be any simple relation between them. It is certain, however, that under diminished pressure less sugar is decomposed than during an equal time at the ordinary pressure, and that the proportion of the carbonic acid to the alcohol produced is greater. This difference was not due to any injury of the yeast cells caused by the removal of the pressure, but appears rather to be an exemplification of Sorby's law, "that pressure weakens or strengthens chemical affinity, according as it acts against or in favour of the change of volume," since the author has proved that there is a decided contraction in volume during the alcoholic fermentation. The formation of acetic acid noticed in Part I. of this memoir the author finds to be derived directly from the sugar.

After the PRESIDENT had thanked the author in the name of the Society,

Mr. BEANES said he would like to hear from the author of the paper whether he had tried fermentation under pressure, because in July last he (Mr. Beanes), during some investigations on saccharine solutions, had occasion to place a saccharine solution of 1050 sp. gr., while in a state of fermentation, under a pressure of 36 atmospheres for two days. He found, at the end of that time, on testing it, it marked 1030 sp. gr.; while another portion of the same liquid, which had not been under pressure, marked 0·996. He thought it peculiar that the same results, viz., a decrease of fermentation, as described by the author of the paper, should be obtained by a partial vacuum, while he (Mr. Beanes) had obtained the same result by an increase of pressure.

A paper "*On Cymene from Different Sources Optically Considered*" was then read by the author, Dr. J. H. GLADSTONE, in which he communicated the results of his optical examination of the cymenes from various sources, recently described by Dr. C. R. A. Wright, which are practically the same for each, their specific refractive energy being 0·55, and their mean refraction equivalent 75·1, the difference of the extremes not being greater than that usually observed between different specimens of the same hydrocarbon. This equivalent, calculated with the common refraction equivalents for carbon (5) and hydrogen (1·3), would give 68·2; thus all these specimens of cymene showed a higher equivalent characteristic of the great aromatic group. This is particularly interesting, as some of them were prepared from substances which do not exhibit this abnormal influence on light, affording additional evidence that the retarding power of the carbon in such bodies as these does not arise from any particular internal structure capable of being transmitted from one compound to another.

After the usual vote of thanks to the author, Dr. ARMSTRONG observed that Landolt had found that, although the refraction equivalent was too high in aromatic bodies when calculated from the empirical formula, yet if in the rational formula the ordinary value for carbon was taken for the substituted radicals, and a higher one for the C_6 in the benzol nucleus, concordant results were obtained.

Dr. GLADSTONE replied that he believed he was the first to point out this, but at present, although it was true for certain compounds, more data were necessary to fix the value for the carbon in the nucleus.

Dr. C. R. A. WRIGHT said it was probable a correlation between this and other physical properties of bodies would be found, as, for instance, in the different amount of heat given out by isomeric hydrocarbons on combustion; although the results were at present incomplete, he had found this to be the case with those of the series $C_{10}H_{16}$.

A "*Note on the Action of Bromine on Alizarin*," by W. H. PERKIN, F.R.S., was then read by the author. Bromine does not act readily on dry alizarin; but, when the two substances are heated to about 170° with carbon disulphide, a brominated alizarin is produced, which, after crystallisation from glacial acetic acid, is obtained in tufts of orange-red coloured needles having the composition $C_{14}H_7BrO_4$. It dissolves in caustic alkalies with a blue-violet colour, similar to that obtained with alizarin, and giving a similar absorption-spectrum. Bromalizarin dyes mordanted fabrics a redder violet with iron, and a browner red with alumina mordants, than is obtained with pure alizarin. Heated with acetic anhydride, it forms *diaceto-bromalizarin*, $C_{14}H_5Br(C_2H_3O)_2O_4$, a yellow crystalline substance.

After the usual vote of thanks, a memoir "*On some Oxidation and Decomposition Products of Morphine Derivatives*," by E. L. MAYER and C. R. A. WRIGHT,

D.Sc., was read by the latter. The authors state that, when apomorphine hydrochloride is heated with an excess of a solution of potassic hydrate, the precipitate at first produced is rapidly dissolved, and the solution acquires a dark colour, from absorption of oxygen. On acidifying it with hydrochloric acid and agitating with ether, a peculiar colouring matter is extracted; the ethereal solution, agitated with an alkaline solution, colours the latter grass-green, and on neutralising with hydrochloric acid indigo-blue flakes are precipitated, having the composition $C_{40}H_{34}N_2O_7$. Diapomorphine and deoxymorphine also yield this blue product when treated with potassic hydrate, but the "tetra" series and the monomorphine derivatives do not—the latter giving methylamine and pyridine, the "tetra" bodies methylamine only and no pyridine. A note to this paper, by Dr. Wright, gives the properties of some colouration products obtained as precipitates by the treatment of certain codeine and morphine derivatives with argentic nitrate and nitric acid. He mentions, as a remarkable fact, that the mother-liquors from which they had been deposited when distilled with caustic potash, yielded methylamine in the case of the morphine compounds, and none in the case of the codeine derivatives, although codeine is methyl-morphine.

Thanks having been returned to the authors for their paper, Mr. R. Warington read his communication "*On the Decomposition of Tricalcic Phosphate by Water.*" The author, after noticing that it had been observed long ago that the mono- and di-calcic phosphates are decomposed when boiled with water, drew attention to the fact that the tricalcic salt is likewise decomposed under similar circumstances. On boiling carefully-washed pure tricalcic phosphate with distilled water for two hours, the solution becomes distinctly acid, and on pouring off the water, and repeating the process ten or twelve times, a compound was at last obtained which had the composition $3(Ca_3P_2O_8)CaOH_2O$, corresponding to apatite, in which the fluoride or chloride of calcium is replaced by the hydrate. The author concluded his paper by some remarks on the solubility of tricalcic phosphate in cold water.

The President then thanked the author for his paper, and for drawing their attention to the formation of this quasi-apatite.

Mr. Warington, in reply to a question of Mr. J. Newlands, said that the pure tricalcic phosphate was prepared from a solution of disodic phosphate, to which an equivalent of ammonia had been added by precipitating it with pure calcic chloride.

Dr. H. E. Armstrong then read a paper entitled "*Communications from the Laboratory of the London Institution*" (No. XII. "On the Nature and some Derivatives of Coal-Tar Cresol," by H. E. Armstrong and C. L. Field. This investigation has for its object the comparison of the haloid and nitro derivatives of cresol and phenol; and for this purpose the authors converted the crude coal-tar cresol, boiling between 190° and 205°, first into the sulphonic acids, and then into the corresponding potassic salts, of which they have succeeded in isolating two, viz., a sparingly soluble one, $C_7H_7O(SO_3K)+2$ aq, and a very soluble salt, $C_7H_7O(SO_3K)$; the former of which yields a very difficultly soluble baric salt when precipitated with baric chloride, and is doubtless identical with Engelhardt and Latschinoff's paracresol-sulphonic acid. The mother-liquors appear to contain a third salt, which has not yet been examined. Both these acids yield mononitro derivatives by the action of nitric acid, which are converted into dibromonitrocresols by treatment with bromine. When the crude cresol is acted on by dilute nitric acid, and the product distilled in a current of steam, crude nitrocresol passes over as a yellow oil, whilst a black residue is left in the retort. The oil readily yields a dinitrocresol melting at about 82°, and forming magnificent red potassium and sodium compounds; it is apparently identical with the dinitrocresol obtained by the action of nitrous acid on toluidine.

The eighth communication was "*On a New Tellurium Mineral, with Notes on a Systematic Mineralogical Nomenclature,*" by J. B. Hannay. Whilst examining a specimen of arsenical iron pyrites, the author discovered in it some metallic tellurium, and also a substance in scales resembling specular iron ore. The latter, on examination, was found to contain arsenic, tellurium, and sulphur, in the proportions corresponding nearly to the formula $Te_2As_2S_7$. After a few remarks on the want of a systematic nomenclature in mineralogy, the author calls the new mineral "arsenotellurite," proposing to name minerals according to the principal constituents—thus, for example, limestone would be "calcite;" and when there are many minerals having the same principal constituents, to add a distinguishing prefix—thus, agate would be called "concentric ferruginous silicite," and so on. A long list of minerals, with the proposed new names, is appended to the paper.

The following paper, a "*Note on Relations among the Atomic Weights,*" by J. A. R. Newlands, was then read by the author:—In the June number of the *Journal of the Chemical Society* is a paper by L. Meyer, "On the Systemisation of Organic Chemistry," in which reference is made to M. Mendelejeff as having shown that certain properties of the elements appear "as a regular periodical function of the atomic weight, if the elements are arranged in the natural system, or according to the numerical values of their atomic weights." Now, in a paper read before this Society on March 1st, 1866, I showed that, when "the elements were arranged in the order of their atomic weights, a simple relation existed between them, those belonging to the same group standing to each other in a relation similar to that between the extremes of one or more octaves in music." I had also previously published the same statement in the Chemical News, vol. x., p. 94, and on other occasions. As my paper was not printed in the *Journal of the Chemical Society*, and therefore a question of priority may arise, I have to request, as a simple matter of justice, the insertion of this brief note in the Society's *Journal*.

The President said the reason why Mr. Newlands's paper on this subject in 1866 had not been published by the Society was that they had made it a rule not to publish papers of a purely theoretical nature, since it was likely to lead to correspondence of a controversial character.

The President then adjourned the meeting till after the recess, congratulating the members on the flourishing state of the Society and the number and importance of the papers which had been read there during the session.

CORRESPONDENCE.

ACETAMIDE AND ETHYLATE OF SODIUM.

To the Editor of the Chemical News.

Sir,—It is evident that Mr. Wanklyn does not know what he is talking about when he makes such a communication as that which I read in your last number, p. 302. Those acquainted with the substance of my paper know that, when sodium alcohol and acetamide are heated together, less than 5 per cent of the ammonia obtainable from acetamide is given off, and that the amount of ammonia depends upon how far moisture gains access to the materials. The conclusions I arrived at were that perfectly dry acetamide and dry sodium alcohol yield no ammonia of any kind, neither do they produce a new compound. This was not apparent from your reporter's notice; I therefore ask you to be so good as to publish this.—I am, &c.,

W. N. Hartley.

King's College, London,
June 22, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, June 2, 1873.

Action of the Chief Derivatives of Amylic Alcohol upon Polarised Light.—I. Pierre and E. Puchot.—Amylic alcohol has an action upon polarised light resembling that of a solution of sugar of 1·4 per cent, but of an inverse direction. The authors found, in all the experiments to which they submitted the pure amylic alcohol of fermentation, no indication of the second amylic alcohol pointed out by Pasteur. The action of ordinary amylic alcohol upon polarised light is increased one-third by the addition of about 6 per cent of water. Amylic alcohol, reproduced from its ethers, or obtained as the residue of an incomplete oxidation, does not appear to have undergone any appreciable modification either in the direction or the intensity of its action upon polarised light. This is not the case with its ethers, nor with the compounds formed under the oxidising influence of a mixture of sulphuric acid and bichromate of potash, along with the necessary amount of water. The first of these oxidation products, amylic aldehyde, turns the plane of polarisation in an opposite direction; in the same, namely, as would be produced by crystallised sugar. With the pure aldehyde this deviation is equal to that which would be produced by a solution of crystallised sugar at 1 per cent. Its degree of purity has a great influence on the extent of deviation. A sample of crude aldehyde, saturated with water, gave a deviation three times greater than does the pure substance. The presence of the water was, however, found not to be the cause of this increased action, since a sample of pure aldehyde saturated with water exerted a rotatory power decidedly inferior to that of the anhydrous aldehyde. The second product of oxidation, valerianate of amyl, (isomeric with the aldehyde above mentioned) causes a deviation in the same direction—but seven times greater—equal to that of a solution of crystalline sugar of 6·6 per cent. The results obtained with the amylic compounds are represented in the subjoined table; the sign + being attached to the deviations similar in direction to crystalline sugar, and — to those in the inverse direction:—

	Sp. Gr. at 0° C.	Boiling-point. Degrees.	Deviation. Degrees.
Valerianate of amyl ..	0·8740	190·0	+ 40·0
Butyrate of amyl	0·8769	170·3	+ 8·5
Valerianate of butyl ..	0·8884	173·4	+ 3·0
Valerianate of propyl ..	0·8862	157·0	+ 9·0
Valerianate of ethyl ..	0·8860	135·5	+ 12·5
Valerianate of methyl ..	0·9005	117·5	+ 8·5
Valerianic acid (monohydric)	0·9470	178·0	+ 5·0
Anhydrous amylic alcohol	0·8255	130·0	— 8·5
Do. do. with 6 per cent water	—	—	— 11·0
Amylic aldehyde (pure) ..	0·8209	92·5	+ 6·0
Do. do. crude (hydrated	—	—	+ 18·0

Two active isomeric bodies like valerianate of butyl and butyrate of amyl are not necessarily equal in rotatory power. There does not seem to exist any definite relation between the rotatory power of two isomeric active bodies and their respective specific gravities.

Detection and Determination of Sulphate of Lead in Commercial Chromates of Lead.—E. Duvillier.—The methods used to decide on the purity of a chromate of lead do not indicate whether sulphate of lead be present or absent. The author heats gently, in a flask of sufficient size, 1 part of the sample of chromate with 2 to 3 parts of nitric acid at 1·420° sp. gr., 1 to 2 parts of water, and ¼ of alcohol. The reaction is very strong, and must be moderated by reducing the heat. When the violent action has subsided, heat is still applied till all nitrous fumes have disappeared. In the flask will be found a violet liquid—a mixture of nitrate of lead and nitrate of chrome—and a white precipitate of nitrate of lead, along with which sulphate of the same metal may be present. Water is added and the whole boiled. If no sulphate is present the whole dissolves; but otherwise sulphate of lead remains insoluble. To determine its amount the whole is evaporated to dryness to expel nitric acid, and the products of the oxidation of alcohol, care being taken not to heat so strongly as to decompose the nitrate of chrome. On treating the residue with water the sulphate is left undissolved. This method is applicable to all chromates.

Action of Nitric Acid upon Chromate of Lead.—E. Duvillier.—In allowing nitric acid, diluted with 1 to 2 volumes of water, to act at the boiling-point upon pure chromate of lead the liquid took the colour of chromic acid, and preserved it on cooling, although the bulk of the chromate of lead remained unchanged. On concentration crystals of nitrate of lead were deposited. The mother-liquor evaporated to dryness yielded a solution of chromic acid nearly pure, but representing a very small part only of the chromic acid present in the quantity of chromate employed. The action of the nitric acid is, therefore, analogous to its behaviour with chromate of baryta. With the latter, however, the amount of water is immaterial, whilst if water be added to a solution of chromate of lead in nitric acid this salt is precipitated. On treating the chromate of lead with double its weight of nitric acid we obtain a solution of chromic acid containing only 2 per cent of lead oxide. Nitric acid, therefore, resolves chromate of lead into chromic acid and into nitrate of lead, which is precipitated at a boiling heat in presence of the excess of nitric acid employed.

On a Base Isomeric with Piperidine, and on the Nitro Derivatives of the Hydrocarbons of the Formula $C_{2m}H_{2m}$.—H. Gell.—Meyer and Stuber have lately prepared isomeric compounds of the nitrogenous ethers formed by wood-spirit, alcohol, and oil of potatoes. These new substances behave like nitro derivatives of hydrocarbons of the general formula $C_{2m}H_{2m+2}$. This discovery of these compounds tends to disprove the essential difference which had been assumed between these carbides and those of the aromatic series, $C_{2m}H_{2m-6}$, the only group whose nitro derivatives were known. The author endeavoured to obtain analogous compounds of another family, still resulting from the substitution of an equivalent of hyponitric acid for one of hydrogen. He sought to prepare the nitro derivatives of the hydrocarbons $C_{2m}H_{2m}$. Having added to nitrethane the quantity of potassa dissolved in alcohol necessary for its transformation into potassic nitrethane, it was placed in contact with an equivalent of iodide of allyl. On adding water to the filtrate an oily liquid was obtained which could not be purified for analysis as it was decomposed on volatilisation. On treating it with hydrochloric acid and fragments of zinc the insoluble oil disappeared, and on distilling the residual liquor with an excess of potassa a colourless liquid was obtained which, on the addition of some fragments of potassa, gave an odour of piperidine. The new substance differs from that base in several important respects. It boils at 85°, and its isomer at 106°. It is soluble in water and alcohol, and combines energetically with acids. If poured upon bisulphide of carbon it gives rise to a brisk reaction, but the liquid does not crystallise

on cooling like piperidine. The author concludes that it is a primary mono-amine of the formula—

$$\left.\begin{matrix} C_{10}H_9 \\ H \\ H \end{matrix}\right\} N$$

Note on the Transit of Venus in 1882.—M. Pinseux.—The author gives a number of particulars as to the circumstances of observation. He points out that the shortest transit will be observed in the neighourhood of New York, and the longest (in accessible regions) in Terra del Fuego and adjacent islands, the difference of duration being about sixteen minutes. The most retarded ingress will be observed in Canada and New Britain; the most accelerated in the island of Kergualen, between which and Montreal the difference will be more than fifteen minutes. The most accelerated egress will be observed in the Antilles and Euzana; the most retarded in the eastern part of Australia, *e.g.*, Sydney; the difference from the time of ingress being about fifteen minutes. The determination of parallax by observations of contact will be in less advantageous circumstances than in 1874. In the latter case, with accessible regions the differences of duration of transit reach twenty-six minutes, the differences of times of ingress twenty-one minutes, and those of times of egress eighteen minutes; while in 1882 the differences will be reduced, the first to sixteen and the two others to fifteen minutes. Instead of observing the hours of contact, however, the parallax might be deduced from measurements made during the transit, and giving at various instants either the angular distances of the centres of Venus and of the sun, or the angle of position of Venus. M. Puiseux illustrates these points.

Trial during a Solar Eclipse of the New Spectroscopic Method Proposed for the Approaching Transit of Venus.—P. Secchi.—His method is as follows:—A highly dispersive direct-vision prism is placed about 25 c.c. before the slit of an ordinary spectroscope supported on the same tube. This gives in the plane of a slit a coloured image of the sun in the form of a very impure spectrum. The rays transmitted thence through the spectroscope form in the field of the small telescope a very distinct solar image, in which not only the border of the disc, but also the spots and the faculæ are quite visible. The sun is seen, in fact, as with coloured glass. When the image is received so that it is formed by red rays, then by putting the Fraünhofer line C near the sun's border at the exterior, one sees the chromosphere as a bright line separated from the solar disc by a distance equal to the height of the chromosphere; but one may at will displace this line according to the part of the chromosphere to be observed, even to contact with the sun's border. Hence, when the dark star covers the chromosphere in points situated in the field of the telescope, one will see this bright line interrupted, and be advised that the star approaches contact. One may then follow its movement by placing the slit near the border, and as the border itself is distinctly seen may estimate very exactly the instant in which (the line disappearing) the border of the dark star eats into the disc of the bright star. P. Secchi observed the recent eclipse thus, and found the results fully up to his expectations. P. Rosa and P. Ferrari also made observations at the same time; the former with a Weil refractor, magnifying 80 times, the latter with a Cauchoix telescope magnifying 120 times; and from comparison of the mean result with P. Secchi's it appears that first contact was anticipated by P. Secchi by 11·9 seconds, while the egress was retarded by 12·2 seconds; the method gives more precision. Comparing his results with those of M. Respighi, who used an ordinary spectroscope according to a method proposed by Zollner, P. Secchi finds M. Respighi in advance of him at the commencement and behind him at the close, the difference of duration being 34·2 seconds; but he gives reasons for thinking this result excessive; chiefly the sun's border seen by Zollner's method is imperfectly defined. The writer makes these suggestions:—(1) For the first notice of the phenomenon use the ordinary spectroscope as for observation of protuberances; (2) having ascertained the ingress of Venus on the chromosphere mount the prism before the slit to obtain a distinct and direct solar image in the field of the spectroscope (an objective prism is preferable to a direct-vision prism); (3) for the second interior contact use either this method or the ordinary.

Action of the Electric Fluid on Flames, Liquids, and Powdery Substances.—Second note by M. Neyreneuf.—The writer examined flames containing no solid particles. In pure hydrogen there was a sensible attraction by a negative print; in carbonic oxide and sulphide of carbon the attraction was more marked, and to both points. Alcohol behaves like ordinary gas. Retreat of the flame is most marked with essence of terebenthin (burnt in a lamp). If the electric point be directed normally to the surface of liquids in a conducting cylindrical capsule an umbilicus is produced for both fluids in water, oil, sulphide of carbon, essence of terebenthin. With badly conducting liquids, if one withdraws the point after having immersed it some millimetres, a liquid cone remains adherent as long as the electricity passes. Few powders give distinct effects. The blue sand used for drying with is best. Either electric point held a little way off produces centrifugal effects, while if the negative point be held very near there is a centrifugal aspiration. On contact one may, as with liquids, raise and maintain a cone of grains during passage of the current.

Molecular Rotation of Gases.—M. Hinrichs.—In the molecular theory of gases only the movements of translation have been considered, and as if these molecules were small globes perfectly elastic; whereas they are composed of several atoms held at some distance from each other. The author deduces from mechanical laws that these non-globular molecules have a movement of rotation about the natural and principal axis, for which the moment of inertia of the molecule is a maximum. A knowledge of the moment of inertia of molecules has led him to calculate the boiling-points of isomers, and details will be given in his forthcoming work on molecular mechanics.

General Results of Analysis of the Glyserian Springs in the Island of San Miguel (Azores).—M. Fouqué.—Chemical analysis reveals in all the waters of San Miguel the original existence, but in various proportions, of saline compounds identical with those obtained by condensing the fumes of a volcano in action, or lixiviating cold lava; and also the presence of the most common volcanic gases.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, May 26, 1873.

Aromatic Amide Acids with Alcohol Radicals.—Peter Griess.—The author has previously shown that in certain aromatic amide acids 1, and also 2 atoms of hydrogen can be easily replaced by alcohol radicals. He has since attempted to substitute a third atom in the same manner, and in some cases successfully. The compounds thus obtained differ very essentially from the amide acids previously described, and containing 1 or 2 atoms of an alcohol radical. The latter still possess the double attributes of acid and base, whilst the amido acids with 3 atoms of an alcohol radical have entirely lost the power of forming metallic salts, and, strictly speaking, cannot be classed as acids. They behave more like organic bases, and seem most closely connected with a little known class of basic bodies, to which Liebreich's oxyneurine and Scheibler's betaine, $C_5H_{11}NO_2$, belong. The first of the compounds obtained, trimethyl-benzo-betain, $C_{10}H_{13}NO_2$, forms small white acicular crystals containing 1 atom of crystalline water, deliquescent in the air, insoluble in ether, very soluble in alcohol, of bitter taste, and without reaction upon vegetable colours. If heated alone to fusion

it is transformed into its isomer, dimethyl-amido-benzoic acid—

$$C_6H_4\begin{cases}CO_2CH_3\\N(CH_3)_2\end{cases}$$

a liquid of faintly aromatic odour and yellowish colour, insoluble in water. Another compound of this class, trimethyl-anisbetaine, $C_{11}H_{15}NO_3$, forms large vitreous prisms, containing 5 atoms of crystalline water. It is easily soluble in water, especially if hot, sparingly in alcohol, and insoluble in ether. At elevated temperatures it is entirely resolved into dimethyl-amido-anisic acid—

$$C_6H_3\begin{cases}CO_2CH_3\\O\ CH_3\\N\ (CH_3)_2\end{cases}$$

a yellowish fluid of faint aromatic odour, insoluble in water, and boiling at 288°.

On Diallyl, and on Attempts to Prepare Allyl-Benzol.—R. Wagner and B. Tollens.—The authors have attempted unsuccessfully to substitute allyl for hydrogen in benzol. In course of their researches they obtained the tetrabromide of diallyl, $C_6H_{10}Br_4$, in four-sided prisms of camphor-like odour, and fusing at 62·5° to 63·5°. As its melting-point is given at 37° the cause of the discrepancy was examined. The authors prepared diallyl by Oppenheim's method (heating the allyl-iodide of mercury with solution of cyanide of potassium) and obtained a product boiling at 58° to 60°. On the addition of bromine a product was obtained, which behaved quite similarly to that prepared by means of the bromide of allyl.

Note on the Detection of Sulphur Compounds by Means of the Blowpipe.—B. Tollens.—One of the simplest methods of testing substances for sulphur compounds is to heat them upon charcoal with soda in the inner blowpipe flame. Remarkably enough it is nowhere pointed out that this test must be performed not with the flame of coal-gas but with an oil-lamp or a candle. Coal-gas contains so much sulphur that soda upon which its flame has been driven for a minute blackens silver strongly, which is never the case with the flame of a candle.

Crystallographic Examination of the Derivatives of Naphthalin.—C. Hintze.—The author, having undertaken a revision of Laurent's labours in the same field, which he pronounces "totally useless for science," remarks that in the substitution of chlorine for hydrogen in the tetrachloride of naphthalin the angles of one crystal zone ($p : p$) remain almost equal, just as has been shown by Groth to be the case with the derivatives of benzol. Here also, therefore, the morpho-trophic action extends only in certain crystallographic directions, with the distinction that this action is stronger in the derivatives of benzol than with those of naphthalin. This fact agrees perfectly with Groth's view that the morpho-trophic action of a substance depends not alone on its chemical nature, but on the structure of the compound into which it enters by way of substitution. Elements are often isomophous in complex compounds, but not in those of more simple structure.

On Œnanthylic Acid and Normal Heptyl Alcohol.—H. Grimshaw and C. Schorlemmer.—Comparative examination of the œnanthylic acid obtained from œnanthol and that prepared from normal heptane gave the following results. The ethylic ether of the acid from œnanthol is a liquid of a pleasant fruity smell, boiling at 186° to 188°. The barium salts of the two acids have the same crystalline form and the same solubility in water. The calcium salts contain 1 atom of crystalline water, and are equally soluble, both forming slender needles arranged in tufts. The copper salts are obtained as somewhat soft precipitates, which on standing become granular. They are insoluble in water, but soluble in absolute alcohol. On evaporating the solutions the salt obtained from œnanthol separates out in small green needles or prisms. On the other hand, that obtained from heptane separates first in a liquid state and then dries up to an amorphous mass. The copper salt of Franchimont's heptylic acid was likewise separated at first in little drops, which congealed to crystals. In other respects the compounds obtained by the authors were very similar to the corresponding salts of heptylic acid. Whether the distinctions observed in the cupric salts are essential must be determined by further experiment. Œnanthylic acid indubitably belongs to the normal series, and as its aldehyde is readily obtained it forms the best material for preparing the normal heptyl compounds hitherto scarcely known.

Affinity of Bromine for Oxygen.—H. Baumhauer.—Thomsen, in an essay on the affinity of oxygen for chlorine, bromine, and iodine, has concluded from thermo-chemical determinations that—in opposition to the prevailing opinion—the affinity between the constituents of bromic acid is considerably less than that between the constituents of chloric acid. This result he pronounces unexpected. In fact several manuals of chemistry state that bromine expels chlorine from chloric acid with formation of bromic acid (see Roscoe's "Outlines of Chemistry"). The author heated a solution of chlorate of potassa with bromine, but on evaporating the residue no bromate could be detected. Neither was any bromate of potassa formed on allowing bromine water to act upon chlorate of potassa with the addition of a little nitric acid—an adjunct which, under parallel circumstances, promotes the formation of iodate of potassa. It seems, therefore, decided that the affinity between oxygen and bromine is less than that between oxygen and chlorine.

Contribution to the History of Sulpho-Urea.—M. Nencki.—If a cold saturated aqueous solution of sulpho-urea is mixed with a solution of cyanide of mercury in equivalent amount, a crystalline double salt is thrown down which, when washed and dried over sulphuric acid, yielded results agreeing with the formula—

$$CSN_2H_4C_2N_2Hg.$$

This compound is sparingly soluble in cold water, and cannot be re-crystallised from hot water, since on heating the aqueous solution a black precipitate of sulphide of mercury is formed, and an odour of hydrocyanic acid is given off. If the solution is boiled till all sulphur is deposited the filtered liquid yields on evaporation crystals of dicyanamide. If sulpho-urea is gently heated with anhydrous acetic acid it dissolves and yields monoacetylic sulpho-urea in yellowish prisms, which can be obtained colourless by repeated crystallisation. Its composition is—

Carbon	30·50
Hydrogen	5·08
Nitrogen	23·72
Sulphur	27·11
Oxygen	13·56
	99·97

agreeing with the formula $C_3H_6N_2SO$, or—

$$CS(C_2H_3O)H_3N_2.$$

This substance is readily soluble in alcohol and hot water, sparingly in cold water and ether. It melts at 11·5° to a colourless liquid. The aqueous solution has a neutral reaction, and forms with the chloride of platinum a crystalline salt sparingly soluble in water—

$$CS(C_2H_3O)H_3N_2HCl,PtCl_4.$$

If acetylic sulpho-urea is distilled with anhydrous phosphoric acid an oil of a pungent odour, heavier than water, distils over.

Determination of Chloral.—V. Meyer and H. Haffter.—The authors remark that chloral hydrate is often found very impure, whence a simple and accurate method for its quantitative examination becomes needful. With aqueous solutions of alkalies chloral hydrate is completely resolved into chloroform and alkaline formiate according to the equation, $C_2Cl_3H_3O_2 + NaOH = CHCl_3 + HCO_2Na + H_2O$. 1 equivalent of chloral hydrate neutralises 1 equivalent of soda, or 165·5 grms. of the former require 1000 c.c. of normal solution of soda. If, therefore, a weighed amount

of the sample under examination is mixed with a known excess of normal soda solution, and the remaining excess of soda is determined by titration with standard acid, the soda consumed and the corresponding amount of pure chloral hydrate are found by the equation—

$$x = \frac{(a-b)\ 165{\cdot}5}{1000}\ \text{grm.}$$

a denoting the number of c.c. of normal soda consumed, and *b* the c.c. of normal acid used for titration. If free hydrochloric acid is present as an impurity, it is neutralised by shaking up the aqueous solution with pure carbonate of lime, and expelling the free carbonic acid by prolonged agitation in the measuring cylinder.

Aromatic Phosphorus Compounds.—A. Michaelis.—Two of the aromatic phosphorus compounds, corresponding to those of nitrogen, are peculiarly interesting; phosphoraniline, $PH_2C_6H_5$ and $PO_2C_6H_5$, both of which had not been obtained. The author passed a mixture of the vapours of benzol and chloride of phosphorus through a glass tube filled with pieces of pumice, and heated nearly to redness. The distillate was returned, and again passed over until 1000 grms. of a liquid, boiling at temperatures higher than 80° was obtained. By fractional distillation a colourless liquid, $PCl_2C_6H_5$, was obtained, boiling at 222°. This substance —phosphenyl-chloride— is a very permanent liquid, refracting light strongly, and fuming in the air with an intense odour resembling both phosphuretted hydrogen and hydrochloric acid. It affords the prospect of a new series of interesting aromatic derivatives.

Behaviour of Ozone with Water.—C. Rammelsberg.—Schœnbein, Marignac, and Andrews pronounce ozone insoluble in water; whilst Soret, Meissner, and Houzeau maintain the opposite view. Carius proved that at low temperatures (0·5° to 5°) oxygen gas, rich in ozone, obtained by electrolysis, forms with water a liquid which gives the reactions of ozone. Engler and Nasse have also convinced themselves of the solubility of ozone. The author examines whether ozoniferous oxygen or air when passed at ordinary temperatures through water would give a liquid capable of producing the reactions of ozone. The result showed that when chlorine was absent the reaction with starch and iodide of potassium was obtained very slightly in one case only, and that with indigo and thallium salt not at all. The so-called "ozone water" of Krebs, Kroll, and Co. contains chlorine, and is pronounced by Dr. Jacobsen to be a dilute solution of hypochlorous acid.

Hydrates of Monobasic Acids.—A. Henninger.—A reply to Geuther's claim of priority for the theory of the hydrates of the fatty acids. He quotes the following formula which Geuther has given for acetic acid :—

$$\begin{matrix} & O \\ \text{IV. H} & \\ \text{C IV.} & \\ & C \end{matrix} \Bigg\{ \begin{matrix} H_2 \\ \\ OH \end{matrix}$$

Sequel to Investigations on some New Derivatives of Sulpho-Carbaminic Acid.—H. Hlasiwetz and J. Kachler.—The authors have found that, with the exception of the aniline derivative, their results had been anticipated by Zeise in 1842.

Remarks on Petersen's Essay "On the Constitution of the Benzols."—H. Salkowski.—A controversial-theoretical essay on the supposed position of the lateral groups in the derivatives of benzol.

Occurrence of Arabic Acid (Gum) in the Sugar Beet, and on Gum-Sugar.—H. Scheibler.—This paper is not suited for abstraction. We shall endeavour to give it in full.

Reimann's Färber Zeitung, No. 18, 1873.

This number consists chiefly of receipts for dyeing and printing upon woollen, cotton, silk, and mixed tissues.

Dyeing Straw Hats.—The articles are boiled in a mixture of 1 lb. sulphate of alumina, ½ lb. prepared tartar, ¼ lb. sulphuric acid, to which orchil, extract of indigo, and turmeric are added as required.

Carminate of Lime.—The compound of carminic acid—the colouring principle of cochineal—with lime is, according to Guignet, distinguished by its black colour from the other cochineal lakes, which are mostly violet. There is consequently always a black precipitate formed when a decoction of cochineal comes in contact with a solution of lime, or even with calcareous water. Pure carminic acid does not, indeed, precipitate gypsiferous water. The reason why decoction of cochineal produces this effect is because it is slightly alkaline. The black carminate of lime can be produced by mixing bicarbonate of lime in solution with decoction of cochineal. The black precipitate is probably neutral carminate of lime, insoluble in water and alcohol. An excess of lime colours the precipitate a deep violet. Concentrated acetic acid dissolves the precipitate with a deep red colour.

No. 19.

The number commences with receipts for sizing linen, for producing ponceau and aniline blue on mohair yarns, superior black on cotton yarns, flamed effects on the same material, deep madder red on wool, naphthalin yellow on woollen yarn, reddish drabs on wool, iodine green on woollen yarn, light and dark maize flesh colour and mulberry on cotton, pensé, crimson, Bismarck, drab, and grey on jute.

Black Spots in Grain Dyeing.—Traces of iron should be carefully avoided in all operations with cochineal, as the compounds of this metal with carminic acid are black. Guignet's opinion that the black spots sometimes found on grain dyed goods are derived from carminate of lime is probably erroneous, as the flot in which these colours are dyed is so acid that any carminate of lime would be at once re-dissolved. Such spots the author considers due to iron present as an impurity in the tin mordants.

Birls in Woollen Tissues.—To remove birls Descoubet saturates the cloth with steam, and conducts it through a narrow slit into a chamber filled with hydrochloric acid gas. Here the cloth is passed several times up and down, and is then conducted into another chamber and dried at a somewhat elevated temperature. It is then run into an alkaline bath, which removes all traces of the acid that has destroyed the vegetable matter.

Aniline Red-Violet.—Hobrecker prepares a reddish aniline by treating rosaniline with iodide of methyl and chloride of benzyl, ($C_{14}H_7Cl$). The metallic green acicular crystals, insoluble in water and sparingly soluble in cold alcohol, are rosaniline, in which 3 atoms of hydrogen are replaced by benzyl, $C_{14}H_7$, the whole being combined with 1 atom of iodmethyl.

Patent Mixture for Cleansing Carpets.—In noticing an English patent for cleansing carpets—which, by the way, prescribes 3½ lbs. soda, and 4½ ozs. washing crystals—the editor very properly remarks that a final treatment with dilute oxalic acid would improve the colours.

Impurities in Tin Crystals.—Bronner recommends dyers to prepare their own bichloride of tin from commercial tin crystals, which, he thinks, are rarely contaminated, except with sulphates of soda and magnesia—substances easily detected by means of chloride of barium. The editor points out that tin crystals are often adulterated with alkaline chlorides, forming double salts much less easily detected.

Preparation of Caustic Baryta.—M. Rosenthiel's process is founded upon the decomposition of sulphide of barium dissolved in boiling water by oxide of zinc. Caustic baryta and sulphide of zinc are formed.—*Year-Book of Pharmacy*.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in utilising waste products obtained in the manufacture of phosphorus, and in the manufacture of certain metallic compounds containing phosphorus. J. H. Player, manufacturer, Birmingham. November 22, 1872.—No. 3501. This invention consists in utilising the gaseous phosphorus compounds obtained in the manufacture of phosphorus by passing the said gaseous compounds through a solution of sulphate of copper; by this treatment phosphide of copper is obtained. The invention further consists in adding phosphorus to copper and alloys of copper for the purpose of giving tenacity and other valuable properties thereto by the use of phosphide of copper instead of uncombined phosphorus, as commonly practised.

Improvements in the mode of and apparatus for treating horny and other analogous animal substances for the purpose of converting them into an elastic substance to be used in place of whalebone, bristles, and for other purposes for which such elastic substance may be applicable. W. Birch, engineer, Penrose Street, Walworth Road, Surrey. November 22, 1872.—No. 3503. The treatment to which the horny substance is subjected (to effect the object of this invention) is a combination of a chemical and mechanical process. The chemical process, which consists in steeping the horny substance in an infusion of sage leaves or plants of that class, is used to soften the substance, and the subsequent mechanical operation is either to flatten, roll out, and extend or mould the softened horny matter, or to disintegrate it into thread.

Improvements in the filtration and purification of fluids, and in the manufacture of manure. David Curror, Wester Craigduckie, Fifeshire, and James Dewar, 15, Gilmore Place, Edinburgh. November 25, 1872.—No. 3529. The features of novelty which constitute this invention are—So using and applying peat (in its natural state, or after being dried or partially carbonised, and either by itself or mixed, or in connection with chalk, lime, sand, earth, or aluminous clay) as a filtering medium or as a discolourising, deodorising, defecating, disinfecting, or absorbing agent or material, that (1) colouring matters in suspension or solution are retained or absorbed, and the fouled water greatly discolourised, clarified, deodorised, defecated, and disinfected, and (2) that the peat (when the fluid passed through it has contained nitrogenous matters) is converted into a valuable manure. This is effected by artificial filtration, the filter bed being made up of ordinary filtering material with a layer or layers of peat of the required thickness laid on the surface of it.

Improvements in manuring, disinfecting, and deodorising. James Raymond Belford, Clifton, Gloucester. November 25, 1872.—No. 3533. This specification describes a manure, and disinfecting and deodorising compound, being a combination of the different salts of ammonia, potash, and soda, sulphates, phosphates, silicates, muriates, &c., in the several proportionate amounts required for the full development of all crops, together with a certain quantity of mineral acids and various phenyl compounds, sulphites, and other antiseptics.

A new or improved industrial manufacture of acetate of alumina, and the treatment of the resulting products. Farnham Maxwell Lyte, chemist, of the firm of Storck and Co., Asnières, France. (A communication from Henri Storck, Edouard Hentsch, Auguste Hentsch, André Lutscher, and Frederic Grininger, constituting the firm of Storck and Co., Asnières, France). November 26, 1872.—No. 3552. The feature of novelty of this invention refers to the manufacturing of acetate of alumina. In carrying out this invention I convert phosphate of alumina into acid phosphate by dissolving it into phosphoric acid. To the liquor I add some acetate of lead in proportionate quantity to that of phosphoric acid therein, that is to say, containing enough lead to precipitate the whole phosphoric acid. Soluble acetate of alumina and unsoluble phosphate of lead are formed. I separate the acetate of alumina by filtration, which I treat afterwards similarly to that obtained by double decomposition with sulphate of alumina for industrial purposes. As to the phosphate of lead, I use it to produce pure phosphoric acid, decomposing it by sulphuric acid or sulphuretted hydrogen, or a phosphate is formed thereof in treating it by an alkaline sulphide, or it may be mixed with charcoal for producing phosphorus by distillation.

Improved process of treating and purifying crude phosphoric acid, and in the production of soluble phosphates, also for the manufacture of phosphorus, and the treatment of certain residues resulting therefrom, and phosphate of alumina. Farnham Maxwell Lyte, chemist, of the firm of Storck and Co., Asnières, France. (A communication from Henri Storck, Edouard Hentsch, Auguste Hentsch, André Lutscher, and Frederic Grininger, constituting the firm of Storck and Co., Asnières, France). November 28, 1872.—No. 3585. The features of novelty of this invention consist—First. In the production of sulphuric acid from phosphoric acid, and certain of its compounds by means of barium and its salts. Second. In the application of phosphoric acid (purified according to this invention) to the manufacture of phosphate of sodium, phosphate of ammonia, and other phosphates, and its employment, as well as the residues in manufactures. Third. In the manufacture of a paste wherewith to charge retorts in the manufacture of phosphorus; the paste is made by evaporating barytated phosphoric acid, and mixing therewith pounded phosphorite or bone-earth and charcoal, and subjected to distillation.

Improvements in the manufacture of sugar, and in apparatus to be used therefor. Alfred Vincent Newton, 66, Chancery Lane, Middlesex. (A communication from Santiago Dod, Havana, Cuba). November 28, 1872.—No. 3588. One part of this invention, which relates to the manufacture of sugar from either the sugar-cane or beet-root, consists in the generation of the steam used in sugar-works (including the supply of the clarifiers, also the working of the pump or pumps, and, if desired, the driving of the engine or engines employed) from the juice itself as a substitute for water, in or during the earliest stages of concentrating the juice, by boiling the latter under pressure in a close vessel or vessels exposed to the direct application of heat, whereby fuel and labour are largely economised. The invention also comprises improvements in the vacuum-pans and other parts of the apparatus employed in the manufacture of sugar.

Analysis of Food, Water, and Air.—Mr. WANKLYN has opened a Laboratory at 117, Charlotte Street, Fitzroy Square, and is prepared to give Practical Instruction in Chemical Analysis to Medical Officers of Health, and to persons proposing to undertake the duties of Public Analysts under the new Act.

North London School of Chemistry, Pharmacy, &c.—Conducted by Mr. J. C. BRAITHWAITE, *for thirteen years Principal Instructor* in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c.

The Session 1872-1873 will commence on the 1st of October when—

The LABORATORY will be open at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Terms moderate.

The CLASSES will meet as usual.

The CHEMICAL and TOXICOLOGICAL CLASS on Monday and Thursday evenings at 8 p.m., commencing October 1st.

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No. 710.—FRIDAY, JULY 4, 1873.

ON BUTTER.*

By J. CAMPBELL BROWN, D.Sc. (Lond.), F.C.S.,
Lecturer on Chemistry and Toxicology at the Liverpool School of Medicine, Public Analyst for Liverpool, Cheshire, and the Isle of Man.

Definition of Butter.—Pure butter is a fat which has passed through the udder of the cow or other animal as one of the constituents of milk, and which has not been decomposed, by keeping or otherwise, into fatty acids and glycerin.

In milk and cream, the fat is all contained in minute round globules, and butter appears, under the microscope, full of these globules. Chemically, it consists of a mixture of neutral fats, the glycerides of the non-volatile acids, palmitinic acid, ($C_{16}H_{32}O_2$), and butyroleic acid ($C_{12}H_{30}O_2$); and the glycerides of the volatile acids, butyric acid ($C_4H_8O_2$), capronic acid ($C_6H_{12}O_2$), caprylic acid ($C_8H_{16}O_2$), and caprinic acid ($C_{10}H_{20}O_2$). (Wagner and Crookes). The last four glycerides are the characteristic fats of butter.

When butter has been decomposed, the rancid taste and smell make its condition evident to every one. The skill of the analyst is most frequently directed to the detection of fats from the flesh of animals or from the vegetable kingdom. The fats which are generally used as adulterants or as substitutes for butter are suet, tallow, dripping, lard, a mixture of refined fats sold under various names, palm and similar vegetable oils. The most characteristic ingredients in these fats are stearin, margarin, and palmitin.

Stearin is a crystalline fat, melting at 144° F., and solidifying at 124° F., soluble in hot ether, or in seven times its weight of boiling alcohol, but deposited from both these solutions on cooling.

Margarin forms scales, which melt at about 116° F., and are soluble in warm ether.

Palmitin is a solid crystalline fat, melting at from 113° to 143°, and solidifying at 114°. It is readily soluble in ether, sparingly soluble in alcohol. Stearin, margarin, and palmitin are seldom obtained pure; they occur in Nature dissolved in olein and other oils, which lower the melting-point. For instance, mutton and beef suet, lard, and palm oil melt at temperatures from 25° to 55° below the melting-points of stearin and palmitin.

In drawing up the following table for the examination of butter, I have made free use of the observations of Dr. Ballard (CHEMICAL NEWS, vols. iv. and v.), and the scheme of Dr. Parkes ("Hygiene," chap. v., section xi.); but I depend chiefly on my own observations on a large number of samples from different sources, made during the years 1871 and 1872.

* From the "Liverpool and Manchester Medical and Surgical Reports, 1873." Communicated by the Author.

Table for the Examination of Butter.

1. Weigh out an ounce of the sample of butter which is to be examined, place it in a test-tube seven-eighths of an inch in diameter, and melt by placing the tube in hot water. Place a thermometer, with a pear-shaped bulb, so that the bulb shall be in the middle of the fat about 1 inch below the surface, and allow the whole to cool spontaneously. If the quantity of water in the butter be large, it will collect in the tube below the fat; the casein will also collect in the lower part of the tube. Watch the mass as it cools, and note when solidification commences and when it is complete. The following are the average solidification-points:—

With pure butter the thermometer is obscured between 74° and 68°, and the mass is solid at 60°.

Beef dripping obscures the thermometer at 79°, and is solid at 72°.

Mutton dripping obscures the thermometer at about 85°, and is solid at 84°.

Lard obscures the thermometer at 84°, and is solid at from 79° to 70°, but it often remains as soft as butter at a much lower temperature.

Mixtures solidify at intermediate temperatures.

2. Determine the quality of the butter by the taste and smell of the re-congealed fat and of the original sample.

3. Examine several portions of the original sample by means of a good microscope, using a $\frac{1}{4}$-inch or $\frac{1}{8}$-inch object-glass. In butter made from milk or cream, nothing is seen except the characteristic globules, and the granular masses of curd, and the cubical crystals of salt. The hard fats of butter are present in the globules in a state of solution, and are not recognisable in a separate form.

If stearic acid, stearin, or palmitin be present in separate form, they will be recognised by single fusiform crystals, or star-like aggregations of acicular crystals. They indicate the presence of melted fats.

Other substances, such as starch, flour, palm oil corpuscles, Irish moss, colouring matter, &c., may also be distinguished by the microscope, as distinct from butter or fats.

4. Examine the same portions with the same object-glass, together with a polariscope, consisting of two Nicol's prisms and a selenite plate. The crystals referred to in (3) polarise light, and when viewed by the polariscope are more distinctly defined. Particles of suet and other fats, which have not been melted, may also be distinguished by their action on polarised light, by their amorphous form, and by their membranes.

5. Repeat the microscopic examination after the addition of tincture of iodine, acetic acid, and other reagents usually employed to detect substances other than fat.

6. Weigh carefully a convenient quantity of the sample, say 1 oz., in a tared porcelain dish, evaporate in a water-bath, or in air-bath, at 212°, until free from water, and

weigh again; the difference is the amount of water per ounce, which should not exceed 35 grs. (5 to 10 per cent; Parkes).

7. Dissolve the residue in ether, warming gently until the whole of the fat is dissolved, filter through a weighed filter-paper, collecting the filtrate in a beaker, then wash the dish and filter-paper with ether until a total of 5 or 6 ozs. has been used, and allow the whole to stand for some time at a temperature of 65°.

8. Dry the precipitate on the filter-paper, and weigh; deduct the weight of filter-paper; the remainder is approximately the amount of curd, or casein, and salt.

9. Wash the precipitate with boiling water, dry at 212°, and weigh; deduct the weight of filter-paper; the remainder is the amount of curd or casein, which, in good butter, should not exceed 15 grs. per oz. (3 to 5 per cent; Parkes).

10. Estimate the salt, by means of nitrate of silver, in the aqueous washings from (9), or wash another weighed portion of butter thoroughly with distilled water, and determine the salt by nitrate of silver. It should not amount to more than 8 grs. per oz. in fresh butter (0·5 to 2 per cent; Parkes), or 35 grs. per oz. in salt butter (8 per cent; Parkes).

11. If the ethereal solution of the fat from (7) has formed a deposit at 65°, decant and filter off the clear solution, and examine the deposit, which is probably stearin, according to (12).

Evaporate the ethereal solution down to 4 ozs., and allow it to stand for several hours at 65°. Filter off the deposit, which probably still contains stearin, and examine it also according to (12).

Allow the ethereal solution to evaporate down to 3 ozs., and allow it to stand for some time at 65°. Filter off the deposit, which may still contain some stearin mixed with palmitin, and examine it separately, according to (12). If the butter is adulterated, some of the stearin, and much of the palmitin, will still remain in solution, and may be obtained by continuing the process of spontaneous evaporation.

Some samples of pure butter yield no deposit from 3 ozs. of ether at 65°; but fairly good butter will generally form a slight deposit, the amount of which varies in different samples. A sample of butter known to be pure should be examined side by side with the sample suspected to be adulterated; and, as winter butter is a more solid fat than summer butter, the former should be chosen for the comparative experiment.

12. (*a*). Place each of the above-mentioned deposits in a thin weighed glass tube, and, after evaporating off the ether, weigh the fat, and determine its melting-point; melt carefully, and allow it to cool gradually. Place a small accurately graduated thermometer with pear-shaped bulb in the melted fat, and observe the temperature at which the latter begins to solidify. When quite solid, re-warm the tube gradually, by placing it in water, the temperature of which is slowly raised, and observe the re-melting-point of the fat.

(*b*). Or, melt the fats in a thin glass or porcelain dish, floated in water, the temperature of which is slowly raised, a thermometer being placed in the water. In this case the apparent melting-point will be 2 or 3° above the correct figure, but the relative differences between the melting-points of the several deposits will be the same as in (12*a*).

13. Determine the taste and smell of each of the deposits.

14. The number of grs. per oz. may be reduced to parts per cent by multiplying by the factor 0·22857.

University of London.—The following is a list of the candidates who have passed the recent D.Sc. examination:—Branch VI., Electricity—Richard Wormell, M.A., University College and private study. Branch XIV., Geology—Augustus Constable Maybury, Royal School of Mines and University College.

INVESTIGATIONS ON PARASULPHOBENZOIC ACID.

By IRA REMSEN.

(Concluded from p. 280.)

V. *Attempts to Prepare Orthosulphobenzoic Acid.*

THE fact that in the crude sulphotoluenic acid, employed in the preparation of parasulphobenzoic acid as above described, two varieties are contained, viz., the ortho- and para-; and, further, the fact that the crude product of the oxidation, in the form of the potassium salts, when fused with potassium hydroxide, yielded, as we have seen, salicylic as well as paraoxybenzoic acid, showed plainly that the ortho-acid had not been destroyed by the oxidising agent. The process was in other cases continued for a long time, and a large excess of the oxidising mixture employed; and still salicylic acid was obtained, its quantity, as compared with that of paraoxybenzoic acid, appearing rather to be increased than diminished under these circumstances.

This result was not what might have been anticipated after Fittig had called attention to the fact that ortho-compounds conduct themselves toward oxidising agents differently from the compounds of the two other series, the former being, as he states, completely destroyed, yielding carbonic acid and water. In the case under consideration two explanations might be given: either the orthosulphotoluenic acid had been converted into orthosulphobenzoic acid, or it had withstood the action of the oxidising mixture; for orthosulphotoluenic acid itself, when fused with potassium hydroxide, yields salicylic acid, if the heating be continued long enough, as was shown by Wolkow (*loc. cit.*).

The solution which yielded the acid barium parasulphobenzoate was evaporated down gradually, and, after it was reduced to a small volume, it was still found to contain a considerable quantity of an easily soluble salt, differing entirely from the difficultly soluble parasulphobenzoate. This was re-crystallised a number of times, and finally obtained in the form of microscopic needles; though even after repeated re-crystallisations its appearance hardly warranted the conclusion that it was a pure compound. It was, as stated, easily soluble in water; and the difference between its solubility in cold water and that in hot was not very great; so that the crystallisation was necessarily brought about by allowing the solution to stand for a length of time over sulphuric acid. The salt thus prepared was analysed after being thoroughly dried over sulphuric acid.

0·4215 grm. of the salt, on being heated to 240°, lost 0·0155 grm. H_2O, and then gave 0·2228 grm. $BaSO_4$ = 0·121 Ba.

	Calculated.		Found.
$(C_7H_7SO_3)_2$ ..	342	68·80	—
Ba	137	27·58	28·71
H_2O	18	3·62	3·68
	497	100·00	

Though the results of this analysis agree but poorly with the calculated percentages, it nevertheless makes it appear exceedingly probable that this easily soluble substance is nothing but the salt of orthosulphotoluenic acid. Acid barium sulphobenzoate requires much less barium (23·10 per cent) and much more water (3 mol. = 9·11 per cent). The fact that more barium was found than is required by the theory would appear to indicate that the salt was rendered impure by the presence of a small amount of a neutral barium salt of sulphobenzoic acid. As the neutral barium salt of parasulphobenzoic acid corresponds in its properties very nearly to the salt here described, this becomes still more probable. Be this as it may, it is evident that the CH_3 group of orthosulphotoluenic acid has not been acted upon by the oxidising

mixture, nor has the acid been destroyed. The same results were obtained when a large excess of sulphuric acid and potassium bichromate were allowed to act upon the mixture of the two sulphotoluenic acids for a long time; so that the statement of Fittig, that the ortho-compounds are destroyed by oxidising agents, requires qualification. It seems, indeed, from this and a subsequent experiment, that the ortho-acid is acted upon with much less energy than the para-acid, if acted upon at all. This case agrees, however, with those mentioned by Fittig, in the fact that the toluen derivative yields no corresponding derivative of benzoic acid.

The destruction of aromatic compounds is by no means confined to those which belong to the ortho-series. The case of salicylic acid mentioned by Fittig is, indeed, no proof of his general statement, inasmuch as all aromatic oxyacids, as far as I have subjected them to experiment, are destroyed with equal facility. I have, for instance, treated salicylic, oxybenzoic, paraoxybenzoic, protocatechusic, and gallic acids with sulphuric acid and potassium bichromate, and in each case exactly the same phenomena were observed. Gentle heating was sufficient to commence the process, which then proceeded violently to the end, accompanied by an evolution of carbonic acid, without the further aid of heat. On now examining the mixture, not a trace of a solid product could in any way be discovered. So that salicylic acid does not differ in this respect from other aromatic acids containing OH; and its conduct toward oxidising agents is, of course, no proof that it belongs to the ortho-series. This does not, however, detract from the value of Fittig's exceedingly interesting observation; it merely serves to define it more accurately.

That the ortho-compound, in the special case under consideration, is acted upon less energetically than the para-compound, was also shown in a rough way by the following experiment:—The potassium salts of the two sulphotoluenic acids were separated very nearly by means of crystallisation. The pure para-salt was introduced into the oxidising mixture, and the reaction that ensued carefully observed. The same quantity of ortho-salt, still containing some of the para-salt, was afterward introduced into the same quantity of the oxidising mixture as was employed in the former case, and the reaction compared with the former one. A striking difference was observed. Whereas the reaction commenced very quickly with the para-salt, and a strong evolution of gas took place; with the ortho-salt, it was necessary to apply heat for a longer time before the reaction fairly began, and then the process was markedly more sluggish, a very slow evolution of gas continuing for a long time. By means of approximate quantitative experiments, further, it was shown that the longer heat was applied to the vessel in which the oxidising process was going on, the smaller was the yield of para-acid; but in no case did I succeed in completely destroying either the ortho- or para-acid. This shows that the para-acid is very susceptible to the action of the oxidising agent, the oxidation taking place apparently at first in the methyl group, and then extending gradually to the whole molecule; whereas the ortho-acid resists the same influence strongly, and if oxidation takes place at all, it breaks up the compound, yielding the last products of combustion. Whether the same is true of other cases I am unable to say; facts do not speak against it at present, and further experiment can alone decide this point, which certainly possesses more than ordinary interest.

I was thus forced to abandon the hope of obtaining orthosulphobenzoic acid by the oxidation of orthosulphotoluenic acid by means of sulphuric acid and potassium bichromate. It is possible that other oxidising agents, as, for instance, potassium hypermanganate, may yield more satisfactory results. A preliminary experiment made with this salt in an alkaline solution showed that oxidation took place readily; and I shall soon commence the study of this reaction in detail.

VI. *Oxidation of the Amides of Sulphotoluenic Acid.*

The difficulty with which ortho-compounds are obtained, and the importance of studying them in a pure condition, in order to complete our knowledge of their conduct under various conditions, led me to undertake one more experiment, with the hope of finding a method for the preparation of orthosulphobenzoic acid. The experiment failed to bring about the desired object, but at the same time gave other interesting results, an account of which follows.

According to A. Wolkow (*loc. cit.*), the amides of the two sulphotoluenic acids can be separated from each other by means of crystallisation. This statement offered a prospect of obtaining an ortho-compound in pure condition; and I hence prepared a quantity of the amides from the crude mixture of potassium salts of sulphotoluenic acids. The perfect separation of the two by means of crystallisation is an exceedingly tedious operation, whether water or alcohol be employed as the solvent. From water the paramide crystallises first, and can then easily be purified; from the mother-liquor a mixture of the two amides is deposited. This fuses at 124°, and can only be resolved into its constituents by a very long series of recrystallisations. I succeeded at last in obtaining a small quantity of the ortho-amide in a pure condition, with all the properties as given by Wolkow.

Now, as the amide contains the group $SO_2.NH_2$ instead of the sulpho-acid group $SO_2.OH$, it seemed possible that its conduct toward oxidising agents might differ from that of the sulpho-acids. No attempts had as yet been made to oxidise compounds containing such a complicated group as $SO_2.NH_2$, and I was obliged to gain a certain amount of preliminary knowledge before proceeding to subject the ortho-amide to oxidation. For this purpose I introduced a few grammes of parasulphotoluen-amide into a noted amount of the oxidising mixture (sulphuric acid and potassium bichromate); and heated the whole gently for a short time. Soon the oxidation began, as was shown by a change in colour and an evolution of gas. The amide dissolved rapidly, and, soon after it had completely disappeared, a beautifully crystallised product began to make its appearance, and increased constantly in quantity. After cooling, the liquid was filtered off. The solid product remained on the filter, after being washed out with cold water, in a pure white condition. It consisted of beautiful, short, lustrous prisms that bore no resemblance to the original amide. It was found to be easily soluble in alkaline carbonates, carbonic anhydride being evolved, and was re-precipitated from these solutions in crystalline form on the addition of mineral acids. It was almost insoluble in cold water, and difficultly soluble in hot water; and, when only once crystallised from water, it had the form of flattened prisms, sometimes more than an inch in length. These had a high lustre, and while in the solution exhibited a very beautiful fluorescence. It was found to fuse at a very high temperature, but to undergo decomposition before this point was reached. These properties distinguish the new substance from the amide of parasulphotoluenic acid. Its composition was determined by the analysis.

(1). 0·8657 grm. of the substance, thoroughly dried over sulphuric acid, were oxidised in a silver basin with saltpetre and potassium hydroxide (Liebig's method). There were obtained 1·03 grms. $BaSO_4$=0·14146 grm. S.

(2). 0·5505 grm. of the dried substance were heated with soda-lime, and the vapours collected in dilute hydrochloric acid. In this way were obtained 0·262 grm. Pt, corresponding to 0·037163 N.

	Calculated.		Found.
$C_7H_7O_4$	155	77·11	—
S	32	15·92	16·34
N	14	6·97	6·75
	201	100·00	

These results agree with the formula—

$$C_6H_4\begin{cases}SO_2.NH_2\\CO.OH\end{cases},$$

and this formula agrees with the method of formation of the substance. We have—

$$\underbrace{C_6H_4\begin{cases}SO_2.OH\\CH_3\end{cases}}_{\text{Sulphotoluenic acid.}}, \quad \underbrace{C_6H_4\begin{cases}SO_2.NH_2\\CH_3\end{cases}}_{\text{Sulphotoluenamide.}}, \text{ and}$$

$$\underbrace{C_6H_4\begin{cases}SO_2NH_2\\CO.OH\end{cases}}_{\text{New acid.}}.$$

I have given the acid the name *parasulphaminbenzoic acid*, as indicating the constitution which it undoubtedly possesses.

A compound of a similar constitution, but belonging to another series, is already known, viz., the so-called *sulphobenzamic acid*. This was prepared by Limpricht and Uslar*, and by Engelhardt.† The former obtained it by heating sulphobenzamide—

$$C_6H_4\begin{cases}SO_2.NH_2\\CO.NH_2\end{cases},$$

or ammonium ethylsulphobenzoate, with potassium hydroxide; further, by treating the compound $C_7H_6N_2SO_2$ (obtained from sulphobenzamide by treating with phosphorus chloride) with caustic potassa. In both cases ammonia is eliminated. Engelhardt obtained it by means of a complicated reaction, viz., the action of sulphuric anhydride on benzonitrile, other products being formed at the same time. Sulphobenzamic acid being derived thus from ordinary (meta) sulphobenzoic acid retains, in all probability, the meta-position of the substituting groups; and, although it is not proved by experiment, it is probable that the amide group is in this case also situated in the sulpho group, and not in the carboxyl. The name would indicate the contrary; but the analogy that this compound shows with parasulphaminbenzoic acid, in which the amide group is undoubtedly situated in the sulpho group, leads me to believe that the name is incorrect, and that the name metasulphaminbenzoic acid would be more in accordance with the internal character.

To the account given above of the method of preparation and the properties of parasulphaminbenzoic acid, I need only add a few details. For the oxidation the following proportions were found to be most favourable:—To 20 grms. of potassium bichromate are taken 30 grms. of ordinary sulphuric acid, diluted with three times its volume of water; this mixture sufficed for the oxidation of 7 grms. of the pure amide. The amide is introduced into the mixture after the latter has become cool. At first the flask is heated by means of a very small gas-flame. A moderately violent action takes place, and in a short time the amide is entirely dissolved; now in a few minutes the separation of the oxidation product begins. The mass increases constantly in quantity until the liquid has the form of a thick paste. In about an hour from the beginning of the process the oxidation is completed. The whole is now allowed to cool down to the ordinary temperature, the product is filtered off and washed out with cold water, until the wash-water passes through colourless. On the filter is the parasulphaminbenzoic acid in the form of beautiful crystals, which only require to be re-crystallised from water once in order to be made perfectly pure. It is easily soluble in alcohol, and crystallises from this solvent in smaller crystals than are obtained from water; and these do not exhibit the property of fluorescence. It is precipitated in crystals, both from a hot and cold alcoholic solution, by water.

Sulphobenzamic acid crystallises, according to Limpricht and Uslar, in scales like potassium chlorate; according to Engelhardt, in rhombohedral crystals or in needles consisting of aggregates of small rhombohedrons. Heated above the melting-point, it volatilises in white vapours. Distilled with phosphorus pentachloride, it yields a number of products, among which is metachlorbenzoyl chloride. It may be expected that parasulphaminbenzoic acid will under the same treatment yield parachlorbenzoyl chloride, a point which I shall decide by experiment.

Ethyl-parasulphaminbenzoate—

$$C_6H_4\begin{cases}SO_2.NH_2\\CO.OC_2H_5\end{cases}.$$

This beautiful compound is the most characteristic derivative of the acid. It is prepared in the usual manner by conducting dried hydrochloric acid gas into a solution of the acid in absolute alcohol, and afterward heating gently on a water-bath. Water gives no precipitate in the solution thus obtained. The alcoholic solution must be evaporated down to the consistence of syrup; it then congeals on cooling, and consists of a mass of fine, colourless needles. In water it is less soluble than in alcohol; in cold water much less than in hot. When boiled with water, it melts in the liquid before dissolving. From the aqueous solution it separates in the form of long, beautiful needles of a silken lustre. These arrange themselves nearly parallel, and may attain the length of several inches. In connection with the melting-point, this substance exhibits interesting though perplexing phenomena. In order to be sure that it was absolutely pure, I subjected it to re-crystallisation a number of times; though each time it was obtained in the same form, and possessed in the highest degree the appearance of a chemically pure substance. On endeavouring to determine the melting-point, however, I was surprised to find that this varied according to circumstances. When first heated, it melted entirely at 110° to 111°; if it were now removed from the bath, and allowed to solidify, it melted immediately after at 94° to 95°; the longer it was allowed to stand after the first melting, the higher the melting-point became, until finally, in about two hours, it again reached 110° to 111°. Specimens examined at different intervals showed melting-points which varied between the limits mentioned; every time that the substance was melted once and then allowed to congeal, and again immediately examined, the melting-point was found to be 94·95°. This, taken together with the fact that the substance was pure, is certainly very remarkable. It is possible that this case belongs in the same category with that observed by Zincke* in connection with the two modifications of benzophenon, which is in its turn decidedly inexplicable.

Of the ether, a sulphur estimation was made as follows:—

0·2849 grm. of the substance, dried over sulphuric acid, were oxidised with KOH and NO_3K (Liebig's method), and gave 0·2903 grm. $BaSO_4$ = 0·03987 S.

	Calculated.		Found.
$C_8H_{11}O_4N$	197	86·03	—
S	32	13·97	13·99
	229	100·00	

Ethyl sulphobenzamate also crystallises, according to the description, in "splendid, shining needles;" these were determined to be monoclinic prisms. No determination of the melting-point appears to have been made. "It dissolves easily in warm alcohol; somewhat less easily in boiling water."

Barium parasulphaminbenzoate, $(C_7H_5SO_4)_2Ba + H_2O$. This salt is prepared by boiling the acid with barium carbonate. It is easily soluble in cold and hot water, and crystallises in nodular aggregations.

The analysis gave the following results:—

0·497 grm. salt, dried over sulphuric acid, lost, at 200°, 0·0161 grm. H_2O; and gave 0·2094 grm. $BaSO_4$ = = 0·12313 grm. Ba.

* *Ann. d. Chem. u. Pharm.*, cvi., 27.
† *Jahresberichte*, 1858, S. 278.

* *Berliner Berichte*, IV. Jahrgang, 576.

	Calculated.		Found.
$(C_7H_6SO_4N)$ ..	490	72·08	—
Ba..	137	24·68	24·77
H_2O	18	3·24	3·24
	555	100·00	

The corresponding salt of sulphobenzamic acid crystallises with $4H_2O$ as "a soft, wavellite, crystalline mass;" it gives off its water at 110°.

Ammonium parasulphaminbenzoate -

$$C_6H_4\begin{cases}SO_2NH_2\\CO.ONH_4\end{cases}$$

prepared by dissolving the acid in ammonia, is easily soluble in cold and hot water. It easily forms supersaturated solutions, which congeal on being disturbed. It crystallises in beautiful needles or long laminæ.

The ammonium salt of sulphobenzamic acid crystallises in laminæ.

The new acid is thus sufficiently well characterised as a chemical individual by these experiments; but, as it represents a class of derivatives differing from others in their more complicated nature, it deserves a more thorough examination. It is susceptible to the action of ordinary reagents, and yields compounds with them. It can be boiled with concentrated nitric acid without undergoing change, it being thrown down in crystalline form on the addition of water. It is insoluble in fuming nitric acid at the ordinary temperature; but dissolves when heat is applied. On the addition of water to the solution no precipitate is formed; on evaporating, however, a very easily soluble, colourless, crystalline product was obtained. Fuming sulphuric acid also dissolves it with the aid of heat, and as water gives no precipitate with the solution, it is probable that a sulpho-acid is formed; though in this connection it should be remembered that the isomeric body, sulphobenzamic acid, appears to yield sulphobenzoic acid when treated with sulphuric anhydride (Limpricht and Uslar), The study of these reactions I shall take up in due time. Parasulphaminbenzoic acid having a symmetrical structure, the investigation of its sulpho acid offers a possibility of throwing light upon the constitution of the tribasic acids of benzin; the conversion of the two sulpho groups into carboxyl may succeed, though, after the experience of Ascher* with sulphoterephthalic acid, this is hardly probable.

I have already stated that the object of undertaking the oxidation of the amides of sulphotoluenic acids was to open another road with the hope of arriving in the end at a method for the preparation of orthosulphobenzoic acid; I also stated that this object was not attained. Orthosulphotoluenamide still containing some of the paramide was subjected to oxidation. It was immediately noticed that, as in connection with the sulpho acids, the action in this case was not as violent as in the case of the para compound. After heating for some time the product was examined. The parasulphaminbenzoic acid formed was filtered off, and the filtrate extracted with ether. The ethereal extract, on being distilled, left behind a residue consisting of orthosulphotoluenamide with a very little parasulphaminbenzoic acid. The latter can be readily removed by re-dissolving the whole in water, adding a little alkali to the solution, and then again extracting with ether. In this way absolutely pure ortho-amide can be obtained. This was again subjected to oxidation, and, after treating for a length of time, no new product could be discovered in the liquid—a portion of the substance only having been destroyed. Thus we see that the conduct of the ortho-amide is exactly analogous to that of the corresponding sulpho acid; and this serves to strengthen the conclusion drawn in regard to the conduct of ortho compounds in general toward oxidising agents.

The points which have been left unsettled thus far in this investigation will be considered in a second paper on a basis of experiments.—*Am. Journ. Sci.*

* *Ann. d. Chem. u. Pharm.*, cxi., 3.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

LECTURE I.

Introduction—Inter-Relations—Units of Measurement, &c.

"Imponderables," as a technical term, was in the last century a name given to those fluids which were supposed to convey electricity, light, heat, &c.; and, because these fluids could not be isolated and weighed, all that men received through their agency were also named "imponderables." These phenomena are now regarded as being due to motions in ponderable matter, and they are considered rather as forces causing motion in this matter, than either as fluids, or as that which can be conveyed, *i.e.*, carried, by fluids. The term is, however, retained as a brief mode of expressing the subject of this course of lectures, especially as no one can confidently assert that it may not again be reinstated in the position it once occupied.

The "energies of the imponderables," then, is a phrase comprehending all results of those unseen, unknown, and, by man, unweighable powers which pervade space. By such powers, the very sun and planets and stars are so influenced that they move in harmonious union or oneness, and, therefore, the name universe is applicable. With this extensive view of the influences and actions of the imponderables, these lectures are not to be concerned. The bounds of them are, however, easily defined. This earth, and that which man can utilise upon it, are our limits. Even when thus "cabined, cribbed, confined" to the earth and the handiwork of men, still those who have perused and thought over the title, viz., "The Energies of the Imponderables, with especial reference to the Measurement and Utilisation of them," may have commented upon it in spirit, saying, "Fools rush in where angels fear to tread." When body, form, and fashion were first given to the scheme of this course, that great was the presumption, and that great, therefore, would be the failure, were not unknown feelings.

The causes of such views are simple and easily made clear. The energies of the imponderables have, in one form or another, occupied the attention of the most thoughtful, as well as the most practical, men in every age. They may not have given this name to the subject of their investigation, but, call it what you will, the ultimate source of all power that Nature gives to man is to be found in the energy of one or more of those unknown agents to which the name of imponderables has been given. To dwell upon this now would be to anticipate the series of lectures. It may suffice to state that the object of the course is to bring before you illustrations of the modes in which men have been led, or are now being led, to define not only the ways, and varieties of ways, in which each imponderable acts, but also to estimate by those measurements to which men appear in material things, the amount or value (if the word be preferred) of that work in material things done by these imponderable elemental powers. To do this involves references, perhaps, in a few words, to conclusions at which a life of self-devotion to one cause may have arrived, that life, too, being aided by the very highest of cultivated mental intelligence and the capability of employing such powers of scientific research, the very alphabet of which is beyond the attainment of the majority of men.

Whilst thus frankly, and at the outset, admitting how high a class of mind is required for these original investigations, it must not be overlooked that the principles which have governed the researches of these men, and the conclusions at which they have arrived, may be appreciated by many minds.

When the late Mr. Faraday was discoursing "On the

* The Cantor Lectures, delivered before the Society of Arts.

Conservation of Force," he made a statement in relation to an observing and a mathematical mind which will have more weight by your generalisation of his words than by my dilution of them. Hence this quotation:—

"It may be supposed that one who has little or no mathematical knowledge should hardly assume a right to judge of the generality and force of a principle such as that which forms the subject of these remarks. My apology is this:—I do not perceive that a mathematical mind, simply as such, has any advantage over an equally acute mind not mathematical in perceiving the nature and power of a natural principle of action. It cannot of itself introduce the knowledge of any new principle. Dealing with any and every amount of static electricity, the mathematical mind can, and has, balanced and adjusted them with wonderful advantage, and has foretold results which the experimentalist can do no more than verify. But it could not discover dynamic electricity, nor electro-magnetism, nor magneto-electricity, or even suggest them; though, when once discovered by the experimentalist, it can take them up with extreme facility. So, in respect to the force of gravitation, it has calculated the results of the power in such a wonderful manner as to trace the known planets through their courses of perturbations, and, in so doing, has discovered a planet before unknown. There may be results of the gravitating force of other kinds than attraction inversely, as the square of the distance of which it knows nothing can discover nothing, and can neither assert nor deny their possibility or occurrence."*

Influenced by such views as these, it seemed that no disrespect to the highest intellect could accrue from an attempt to make clear, even to the lowest, a few of the fundamental principles from which important truths have been evolved. It must be borne in mind that to illustrate the modes by which these energies have been measured and utilised, and not to make any attempt at measuring them, is the leading principle which, thus early enunciated, may prevent misconceptions of the title.

The very words, "Energies of the Imponderables," are, to some minds, terms and not realities—symbols, like political watch-words, serving only to classify their professors—things for *savans* to discourse upon—provinces in that intellectual dreamland in which natural science is supposed to dwell. To the majority of men, to those who toil for their daily bread, and, with all their toiling, find but scant supply, the monastery of science, in which her monks live apart from the world and all its vulgar cares, seems a paradise in which is no unrest. Such is only one of many thousand delusions. Within the thinly-peopled world of those who investigate the laws of Nature, there are all the pleasures and pains which meet the labourer with his spade, the mechanic with his tools, the merchant in his office, or the statesman in his cabinet. It is because students and investigators of Nature's laws live much alone—because they cultivate a species of clanship—because there is amongst them a kind of Hindoo caste—that they are seldom in contact and companionship with the toilers in material things. This is much to be regretted. Although both parties are losers, yet the toilers in material things are by far the greatest losers.

Such men as these are the true pioneers of the human race, and that army is ill-directed which allows the work of preparation done by its pioneers to be so far in advance that the mountains they had levelled were again piled up, the rivers they had dried were again flowing, and the thorns once cleared from the desolate prairies were again rendering the ground unfertile. The men of science are they who give the sap of vitality to the tree of commerce. Society plucks the fruit, and seldom waters the plant. Such has been, and such still is, the case with investigators of natural science, if the men amongst whom they live take the fruit and care neither for the gardeners nor the garden.

Look at the world—the beautiful glass in some of our stained windows is a lost art. Look at the temples in India, illustrations of which the photographs so truthfully reproduced in this room a few weeks since. Civilised Europe and self-satisfied England cannot, either by their St. Peter's at Rome or those recent productions which we are bound to recognise as the highest attainment of national architecture,—the Albert Hall and adjacent memorial,—approach even at a distance. These temples of a religious profession, with which we are not even acquainted, and of which no records remain, abound in an architecture with which neither in its conception nor in its detail have we aught to compare. And of the materials the men of that age used, we may say the stone is stone still; the sharpness of the carvings is sharpness still.

Is all our dolomite a bastard dolomite? Why are we in England obliged to seek for Italians to form our moulds—to pour in the clay, and to sculpture the marble? Why do we go to Germany for our draughtsmen, our science, and our music, and to France for our adornments and our designs?

One illustration of the neglect of obviously social gain from want of scientific attention cannot, in this room, be out of place.

The Society of Arts was founded in 1753, and when the scientifically practical and theoretical minds of Count Rumford and others considered on what basis and why the "Royal Institution of Great Britain" should be founded, they expressed the objects of thus founding a Society which should supplement the work of the Society of Arts in the following title-page to the charter of 1800:—

ROYAL INSTITUTION
OF
GREAT BRITAIN,
For Diffusing the Knowledge and Facilitating the General
Introduction of
USEFUL MECHANICAL INVENTIONS & IMPROVEMENTS,
And for Teaching by
COURSES OF PHILOSOPHICAL LECTURES AND EXPERIMENTS
THE
APPLICATION OF SCIENCE
TO THE
COMMON PURPOSES OF LIFE.

In reference to the necessity for so supplementing the work done here by our predecessors, in order to "advance the applications of science to the common purposes of life," the then managers state that "the giving of premiums to inventors was done by a most respectable society (the Society of Arts), but to diffuse knowledge needed another incorporation."

Whilst admitting how nobly the Royal Institution has done good work, and how generations yet unborn will look back with reverential gratitude to the boons which those who have laboured within its walls have conferred upon men, it is curious to mark how the views of its founders, and the one great purpose of its formation in 1800, are being realised by the Society of Arts in 1873.

In 1800 the managers of the Royal Institution, as their first act, constituted fourteen committees, for the following purposes;—

1. To investigate the various processes used in making bread, with a view to their improvement.
2. To investigate means for producing cheap and nutritious soups for feeding the poor.
3. Improvement of cottages and cottage fire-places.
4. Improvements in the construction of stoves for warming dwelling-houses.
5. Improvements in kitchen fireplaces and kitchen utensils of private families.
6. Improvements of the most useful articles of household furniture.
7. To ascertain, by experiment, the effects of various processes of cookery upon the food of cattle.
8. Improvement of kitchen fireplaces and kitchen utensils used on shipboard.
9. Improvement of lime-kilns.
10. Ascertaining the effects of mixing clay, &c., with coal-dust and cinders, in forming fire-balls and combustible cakes.

* *Proc. Roy. Inst.*, Feb. 27, 1857, p. 364.

11. Improving the composition of mortar and cements.
12. To ascertain the best method of building cottages and farm-houses with earth rammed together.
13. A committee of mechanics for the improvement of useful machines of all descriptions.
14. A committee for improving the various processes necessary in producing iron from its ores. and in working and refining of iron and steel.

Thus did one noble foster-child of this Society prescribe its own duty, and, child-like, neglect that particular duty; and now that the child has attained the age of threescore years and ten, the nursing mother, by gold medals and money rewards, steps forward to complete the work begun by her foster-child,* and further, by these annual Cantor Lectures, she now does that which—not being done in 1800—led to the formation of the "Royal Institution of Great Britain."

This comes of the people of a country allowing the science of a country to dwell alone. All advances are first suggested by men who observe and think; they are extended by men who reason and test; they are utilised by men who act.

The pioneers of an army are not the fighting men; sailors navigate the ship; marines do the warfare.

The men who investigate the laws which govern the energies of the imponderables are not the men to utilise and apply them. The practical knowledge,—the stimulus of interest,—the capital of the manufacturer, are wanting to the philosopher; while the manufacturer on his part is equally in want of the general information and accurate reasoning of the man of science. When the commercial element enters, and another object of regard is set up for worship, the man of science cannot serve two masters; he cannot serve science and mammon. The more earnestly and heartily he serves the former, the less he bows to the latter. The service of natural science has within itself far more ennobling mental rewards than mammon can confer.

Longfellow, in his letter to Agassiz, on his fiftieth birthday (28th May, 1857), after alluding to the sacrifice he made of his country and his home, for the cause of natural history, well expresses what he feels who, single-minded, teaches men to read what is still unread in the manuscripts of God. Agassiz is described as—

> "He who wandered away and away,
> With Nature, the dear old nurse,
> Who sang to him night and day
> The rhymes of the universe."

And then comes a reward more welcome than money or honours—

> "For whenever the way seems long,
> Or his heart begins to fail,
> Nature sings a more wonderful song,
> Or tells a more marvellous tale."

This course of Cantor Lectures, in relation to the energies of the imponderables, is to be an attempt to occupy the border-land between pure scientific research and the ministration to social needs; to tread, in fact, upon neutral ground, to launch our boat upon the Rubicon which divides the provinces of science from those of commerce. It does not aspire to any claim on the nests of science; they who build them are welcome to the imagined and worthless immortality of a name. It does not propound to commerce new modes of amassing wealth. They may keep their wealth who can. But it does seek to bring before those whose daily bread and daily luxuries are derived from science, illustrations of some of the truths on which their daily labour rests. It will try to do this in plain and simple form, divested of those higher studies through which these truths have been in some measure attained, and in a thousand ways extended.

That the work is one worthy of all human intelligence may be inferred from the official document given by the authorities of that incorporation of men who are the real rulers of the earth, properly so called. Statesmen and politicians may influence the minds and bodies of men, but engineers influence all material things.

The Institution of Civil Engineers, established in 1818, long before passenger railways, telegraphs, &c., &c., were known, and now numbering among its members men in all parts of the globe, clearly and aptly defined the objects of their incorporation in words well fitted to the purposes of our present consideration. They then (in 1818) defined the object of their association to be "The acquisition of that species of knowledge which constitutes the profession of a civil engineer, whereby the great sources of power in nature—*i. e.*, the energies of the imponderables—are converted, adapted, and applied for the use and convenience of man."

It may be said, and with some show of reason, when the comprehensive title of these lectures is considered, a little well or completely done is better than much ill or very partially done. As a principle in education this is a truism which the Committee of Council on Education and our various School Boards would do well to adopt and illustrate; but these Cantor Lectures are not to be scholastic lessons; they may teach, but the primary object of them is rather to be suggestive of thought—to give the minds of hearers and readers food for reflection, material for development, to arouse inquiry, to provoke investigation; to leave, in fact, an unsatisfied impression that there is more than the lecturer has expressed—and there is much for hearers and readers to consider. If thus they only lay in the foundations of knowledge, and in rough and sketchy outline show the superstructure, they will have done good service—they will have stimulated research, and so led to the acquisition of knowledge and a habit of mind more valuable far than any which can be given from this platform to you who sit at ease on those cushioned seats, willing to rest for a while under the delusive spell that the Society of Arts has thus found a right royal road (and perhaps a pleasant one) to learning. Such an unsatisfied feeling in relation to the energies named, and the measurement and utilisation of them, it is the object of this course to endeavour to create. If this result be attained, then in those future years, when by individual labour present difficulties are overcome, and light shines where thick darkness now overspreads, there will be cause for thanks, where, perhaps, when these lectures end, an unsatisfied longing may alone be found.

(To be continued).

* A sum of £500 having been placed at the disposal of the Council of the Society of Arts, through Sir William Bodkin, by a gentleman who does not wish his name to appear, for promoting, by means of prizes or otherwise, economy in the use of coal for domestic purposes, the Council have decided to offer the following prizes:—(1). For a new and improved system of grate suitable to existing chimneys as generally constructed, which shall, with the least amount of coal, answer best for warming and ventilating a room.—The Society's Gold Medal and Fifty Pounds. (2). For a new and improved system of grate, suitable to existing chimneys as generally constructed, which shall, with the least amount of coal, best answer for cooking food, combined with warming and ventilating the room.—The Society's Gold Medal and Fifty Pounds. (3). For the best new and improved system of apparatus which shall, by means of gas, most efficiently and economically warm and ventilate a room.—The Society's Gold Medal and Fifty Pounds. (4). For the best new and improved system of apparatus which shall, by means of gas, be best adapted for cooking, combined with warming and ventilating the room.—The Society's Gold Medal and Fifty Pounds. (5). For any new and improved system or arrangements, not included in the foregoing, which shall efficiently and economically meet domestic requirements.—The Society's Gold Medal and Fifty Pounds.

CORRESPONDENCE.

ACETAMIDE AND ETHYLATE OF SODIUM.

To the Editor of the Chemical News.

SIR,—My letter, which does not seem to please Mr. Hartley, has caused him to rectify an error into which he is reported to have fallen.

According to the report in the CHEMICAL NEWS, Mr. Hartley said that ammonia is given by the action of

acetamide on ethylate and methylate of sodium. Dr. Armstrong, too, is reported to have obtained ammonia in the same manner. The truth appears to be, however, that acetamide yields no ammonia by action on ethylate and methylate of sodium; but that soda acetamide and caustic soda yield ammonia, and caustic soda always accompanies ethylate of sodium, unless very special precautions be taken to ensure its absence.

Whether Mr. Hartley and Dr. Armstrong said what they are reported to have said, is a question between them and the reporter. My object in writing my letter was to rectify an error, and I believe that I have attained it.—I am, &c.,

J. Alfred Wanklyn.

London, June 30, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, June 9, 1873.

Presence of Avic Acid in a Sample of Guano, and Remarks on the Estimation of the Commercial Value of Manures in Accordance with their Elementary Composition.—E. Chevreul.—In May, 1866, the author discovered in the suint of sheep a substance to which he gave the name of elic acid. It is perfectly liquid below 16°, and becomes somewhat viscous at 15° to 14°. In 1869 he extracted from this elic acid another substance which he named avic acid, because it had a "smell of birds." In 1871 he accidentally recognised the same acid in the feathers of an albatross. He now maintains that he has discovered the same principle in guano. This leads him to urge the importance of immediate or proximate organic analysis as applied to manures in contradistinction to mere ultimate or elementary analysis. The most important study for the progress of agriculture is the determination of the immediate principles of soils and manures, and that of their organoleptic properties. As regards manures, the great point is the study of their immediate principles viewed in relation to the immediate principles of the chief arable soils. The author has shown how soils of different natures act differently with regard to the oily principle which is one of the ingredients of colza oil-cake. The neglect of the proximate analysis of manures explains why avic acid has not been recognised in guano. In analysing some new samples of that manure from Peru he found avic acid, along with carbonate of ammonia in the first, nearly colourless, washings with water. Its odour is not distinctly perceptible until the carbonate of ammonia has been completely evaporated. Guano, he finds, can be entirely freed from carbonate of ammonia by a temperature of 90°.

Researches on New Derivatives of Propyl.—A. Cahours.—He prepares glucinium propyl by acting upon mercury propyl with the finely-divided metal at the temperature of 130° to 135° in a sealed tube. It is a colourless liquid, boiling at 244° to 246°, and giving off dense fumes without becoming ignited. If cooled to −17° it takes the appearance of a fatty oil. Water decomposes it with violence, producing a copious evolution of gas, and an abundant deposit of hydrated glucina. By a similar process he has prepared glucinium-ethyl; which boils between 185° and 188°, and gives off inflammable vapours. Water decomposes it in the same manner as glucinium-propyl. It is also attacked by absolute alcohol, the sides of the tube becoming covered with a transparent crystalline substance. By acting with chloride of silicon upon anhydrous propylic ether the author has obtained compounds analogous to Ebelmen's orthosilicic ether, and to the silicic, mono-, di-, and trichlorhydrines of Friedel and Crafts. The bodies thus obtained are silico-propionic ether, and silico-propionic-, mono-, and dichlorhydrines. Boropropylic ether was obtained by passing very slowly a current of perfectly pure chloride of boron into anhydrous propylic alcohol maintained at a temperature bordering upon zero. The compound in question is represented by the formula $Bo(C_6H_7O_2)_3$. Liebig and Wœhler obtained a crystalline product, known as allophanic ether, by causing the vapour of cyanic acid to act upon absolute alcohol. Hofmann obtained the same compound by allowing alcohol to act upon urea in a cohobator. In this case the formation of allophanic ether is constantly accompanied by that of ureathane or carbamic ether. The author, by replacing ethylic alcohol with propylic alcohol prepared propylic allophanate in nacreous laminæ, sparingly soluble in cold water, but readily soluble in boiling water and alcohol, and fusible between 150° and 160°. Its composition is $C_{10}H_{10}N_2O_6$. Propylurethane, $C_8H_9NO_4$, is obtained in the form of long, colourless, brilliant crystals, easily soluble in water, alcohol, and ether. It fuses between 51° and 53°, and boils at 194° to 196°. If moist it is decomposed by heat, and yields large quantities of ammonia.

Part Played by Atmospheric Nitrogen in Vegetation.—P. P. Dehérain.—The author has previously announced that he had succeeded in fixing atmospheric nitrogen upon the black matters formed during the decomposition of the hydrates of carbon. In more recent experiments he has shown that this fixation takes place at common temperatures, and that it is due to the formation of ammonia. Thus, in one of his experiments the absorbent matter was glucose and ammonia; amount o free nitrogen at the beginning of the experiment, 38 c.c.; ditto, at the conclusion, 21 c.c.; nitrogen taken up, 17 c.c., or 44·7 per cent of the original amount. The presence of cyanides could not be recognised in any of these experiments. It is established that the fixation of nitrogen by carbonaceous matter which takes place at 100° ensues also in the cold, though with less energy. An atmosphere poor in oxygen favours the fixation.

Boiling-Points and the Molecular Volumes of the Chlorated Isomers of the Ethylic Series.—G. Hinrichs.—A physico-mathematical paper.

Ethylacetylen formed Synthetically, and on its Identity with Crotonylen.—L. Pruner.—Ethylacetylen has been formed synthetically by Berthelot, who caused acetylen to act directly upon ethylen at a dull red heat. Crotonylen was discovered by Caventon, who removed 2 equivalents of hydrobromic acid from the bromide of butylen. The mixture of ethylene and acetylene was passed into bottles containing bromine. The bromised liquids, being left for two days in contact with a slight excess of bromide, are passed into tetrabromide, $C_8H_6Br_4$. On expelling the alcohol and crystallising, the compound thus obtained was found to agree in appearance, in properties, and especially in point of fusion with, the tetrabromide of crotonylen described by Caventon.

Synthesis of Phenylallyl.—C. Chojnacki.—The author obtained phenylallyl by heating to 100° under pressure a mixture of equal parts of benzin, and of iodide or bromide of allyl with one-fifth of zinc-powder.

Combinations of Chloride of Titanium with the Ethers.—E. Demarcay.—The author has formed and examined a number of these compounds, which he considers as chlorhydrines analogous to the silicic chlorhydrines of Friedel united to chlorides of the acid radicals. The sulphides and sulphydrates of the alcohol radicals

behave with chloride of titanium in the same manner s normal ether.

On Phenolcyanine.—T. L. Phipson.—(see xxvii., p. 299.)

Remarks on Mène's Observations on the Manufacture of Sulphate of Ammonia from Nitrogenous Refuse.—L. L'Hote.—The process for manufacturing ammoniacal salts patented by Martin, and which Mène pronounces impracticable, consists essentially in the substitution of lime, baryta, &c. for soda-lime. In some cases caustic soda alone is required. The azotised matter is first attacked with caustic soda-lye at 10 per cent, and the mass is afterwards made into a paste with slaked lime. On distillation the combustion of the organic matter is as complete as in the determination of nitrogen by the soda-lime process, and the residue contains neither nitrogenous charcoal nor cyanides.

Determination of Phosphoric Acid in Manures, Coprolites, Phosphatic Minerals, &c.—Ch. Méne.—A critique on the process of Joulie (CHEMICAL NEWS, xxvii. 228, 309, 314). The citrate of ammonia process consists in treating the manure with dilute nitric or hydrochloric acid, and filtering off the insoluble matter. To the clear filtrate is added ammonia, which generally forms an abundant white precipitate. Citric acid is then added till the precipitate re-dissolves, and any insoluble particles are removed by filtration. To the filtrate is added sulphate of magnesia, and then more ammonia. The resulting precipitate is regarded as ammonia, magnesian phosphate, &c., is filtered, washed, and calcined. Without wishing to show how this analysis is faulty, the author insists, on the one hand, on the solubility of ammonia magnesian phosphate in ammoniacal salts, and, on the other, on the precipitation of all the gelatinous silica, which is then estimated as ammonia magnesian phosphate. To be convinced of this it suffices to take a few drops of silicate of soda diluted with water, to add ammonia which gives a precipitate soluble in citric acid, but capable of being precipitated afresh by ammonia. Alumina under the same conditions is not re-precipitated. To give an idea of the error which may be committed Méne quotes the results of an experiment when a fossil phosphate, by the citrate of ammonia process, gave 70 per cent tribasic phosphate of lime, but by Chancel's method—the bismuth process—it yielded only 1·5 per cent. The author agrees with Joulie in his condemnation of the ammonia process (Bobierre's) but recommends in its stead that of Chancel, which he himself has used for ten years, and which is exempt from all errors in excess. (We think it deplorable if any analytical chemist is ignorant of the means for rendering gelatinous silica insoluble in dilute acids, thus avoiding the error in excess pointed out by M. Méne).

Bibasic Sulphate of Lead from Ariége.—Ed. Jannettaz.—The author finds this mineral identical with the bibasic sulphate of Leadhills. He remarks as a strange circumstance that the specimens of Lanarkite examined by Thomson and Brooke should, according to both these authorities, contain a half equivalent of carbonic acid, and should yet agree in their characters with the crystals from Ariége and Leadhills, which contain none.

Extract from Memoir on the Various Causes which Produce Strokes of Lightning.—M. de Fonvielle.—The author seeks to show that two neighbouring conducting objects react powerfully on each other under the influence of a thunder-cloud, and that this reciprocal influence varies according as they are insulated or connected one or other, or both, with the common reservoir; also that a thunder-cloud produces, by the fact of its movement, special reactions—like the plate of a Holtz machine. The induction on the earth's surface he points out must often be strong enough to affect the passage of clouds, giving them a greater velocity before they reach the zenith of the object electrified, or retarding them after they have passed the zenith; and this fact he compares with certain attractions and repulsions between stars, observed by Hansteen and others, and doubtless due to magnetic force; which force appears to have been neglected as being in juxtaposition with that of gravitation: just as the displacement of clouds above referred to is combined with that produced by the wind. The changes in terrestrial magnetism in consequence of star motions are analogous to those which clouds produce in the electrification of the terrestrial surface.

Theory of Sun-Spots, and the Dark Nucleus of the Sun.—M. Vicaire.—This note refers chiefly to M. Respighi's observation of a sinking of the chromosphere at the spots. For this to yield valid support to the cyclonic theory, it must be shown (the author holds) that, supposing the depression certain, (and it has been contested by P. Secchi), it is really due to an engulphing of the chromosphere, and that a turning movement may be there observed; such movement being quite an exceptional phenomenon. Further, according to M. Faye's own calculations, the centrifugal acceleration in the solar cyclone would be only $\frac{1}{187}$ of what produces the terrestrial cyclone. Now the depression of the photosphere at the spots, and also, according to M. Respighi, that of the chromosphere, is equal to several thousands times that produced by terrestrial cyclones. Indeed, a fall of 4 c.c. in the barometric column corresponds at the sea-level to a displacement in altitude of 430 metres or $\frac{1}{15000}$ of the earth's radius, and it is known that there are solar spots the depth of which exceeds this radius. Hence the cause assigned for the spots by M. Faye would be only $\frac{1}{1000 \ldots 181}$ or nearly $\frac{1}{2000 \ldots}$ of the intensity required by the phenomenon. M. Vicaire adheres to Wilson's theory of the sun's composition.

Researches of Spectral Analysis on the Subject of the Solar Spectrum.—Mr. J. N. Lockyer.—A recent communication to the Royal Society.

Reply to Preceding Note of M. Raynaud on the Maximum Resistances of Magnetic Coils.—M. du Moncel.

Relation between Electrical and Capillary Phenomena.—M. Lippmann.—When a drop of mercury in a glass vessel and, covered with sulphuric acid, is put in communication with a point of copper or iron passing through the acid, it suddenly becomes more convex, and an electric current is produced which polarises the surface. The surface contraction is due to a change of capillary constant; this and the electromotive force of polarisation are continual functions of each other. Reciprocally, an extension of surface produced mechanically polarises it as an electric current would. M. Lippmann varies the capillary constant of a surface of mercury in a glass tube, by polarising it with a current from a Daniell element, causing a deformation of the meniscus. He constructs a very sensitive capillary electrometer (for measuring electromotive forces), consisting of a thin glass tube of mercury, which he puts under the object-glass of a microscope for observation of the meniscus as affected by the current. Replacing the pile in the above case by an electrometer or galvanometer, and displacing the mercury mechanically, it can be shown that the electromotive force is varied, the quantity of electricity being independent of the form of the surface, and simply proportional to the area. He also constructs an electro-capillary motor. Two masses of mercury in acidulated water serve alternately as negative electrodes to the current of a Daniell element. In each mass are partially immersed a set of glass tubes open at both ends. At each inversion of the current one set rises, the other descends, and this alternate movement is transformed, by levers, &c., into one of rotation.

Magnetic Observations.—M. Diamilla Müller.—The author has established a temporary magnetic observatory on a hill near Florence, and shortly before the recent eclipse he noticed a stoppage for three quarters of an hour, of the oscillations in his magnetometer (which took on an average twenty seconds), and when they resumed they were much smaller and slower. He thinks this may be due to the special position of sun, moon, and earth, and

not to the eclipse; but invites observation of the oscillations of the needle at the approach of each new moon. He also gives results of the second series of simultaneous magnetic observations made in various parts of the globe on October 15 last. It appears—(1) That the secular variation of the declination is inversely proportional to the distance of the place of observation from the magnetic equator; (2) that the secular variation of the inclination is proportional to the extent of their magnetic parallels; (3) that the secular variation of the intensity (total force) is proportional to the secular variation of the inclination.

Spectroscopic Researches on the Fumeroles of the Eruption of Vesuvius in April, 1872, and Actual State of the Volcanos.—Extract from letter of M. Palmieri's to M. Sainte-Claire Deville.—The writer states that Vesuvius has become very quiet; and that he has found thallium in most of the fumerole sublimations (by spectral analysis) and, in some cases, a product rare in Vesuvius, viz., boric acid.

Reimann's Färber Zeitung, No. 21, 1873.

On Petroleum Benzin. — The author describes the petroleum benzin now coming into use as a substitute for benzol. The new fluid is equally useful for dissolving out fatty and resinous matters, but cannot be used in the manufacture of aniline.

Dyes for Wool.—Receipts are given for a sulphur fast puce, a fast drab, sad green with vat-blue bottom, fast violet with vat-blue and grain, madder drab, dark green, madder ponceau topped with grain.

Alpaca.—Silver grey and brown.

Dyes for Cotton.—The editor gives formulæ for a dull yellowish green, a cinnamon-brown, and a light brown.

Straw Hats with Aniline Colours.—The editor directs that if an aniline colour does not take on from a lukewarm solution, the straw-ware should be steeped in a hot solution of glue, then wiped with a cloth, and placed in the colour-bath.

Manufacture of Magenta without Arsenic.—Meister Lucius, and Co., of Hœchst-on-the-Main, are manufacturing magenta by the action of nitro-benzol upon aniline or toluidine. Coupier maintains that he patented as early as 1866 a process essentially the same.

Oil Colours for Printing.—The following mixture has been recently patented:—13 parts of varnish (what kind?), 5 of oil of turpentine, 1 of white wax, 1 of rosin or, instead, boiled linseed oil, 1 of half-boiled linseed oil, 0·20 of wax (?), 1·98 crude turpentine. Silk, woollen, and cotton tisues can be printed with this composition, and the colours do not wash off.

Annalen der Chemie und Pharmacie, band clxvii., hefts 2 and 3. (Neue Reihe, band xci., 2 and 3.)

On Phenanthren.—M. Hayduck.—Phenanthren crystallises in colourless, shining, occasionally rather large, crystalline scales; melts at 96°; begins to sublime at 100°; and passes over unchanged at higher temperatures. It is readily soluble in hot, and moderately in cold alcohol; and dissolves easily in ether, benzol, bisulphide of carbon, and glacial acetic acid. The solutions display a fine blue fluorescence. It dissolves with a green colour in concentrated sulphuric, and also in nitric acid. Ostermeyer and Graebe have observed that a sulphacid and a nitro compound are formed under these circumstances. A hydride of phenanthren is not formed even on the prolonged action of sodium amalgam upon the alcoholic solution. Its formula is $C_{14}H_{10}$, and its composition is as follows:—Carbon, 94·4; hydrogen, 5·6; total, 100·0. The author has examined the picrate—phenanthren dibromide, $C_{14}H_{10}Br_2$; bromphenanthren, $C_{14}H_9Br$; dibromphenanthren, $C_{14}H_8Br_2$; tribromphenanthren, $C_{14}H_7Br_3$; the chinon, $C_{14}H_8O_2$; and the dibromchinon, $C_{14}H_6Br_2O_2$. From this compound the author attempted, though unsuccessfully, to obtain an isomer of alizarin.

On the Compound $C_{14}H_8S_2$.—C. Paulz.—An account of the preparation, properties, and combinations of this as yet unnamed substance.

On Chlorosulphides of Carbon. — B. Rathke.— A lengthy paper, which does not readily admit of abstraction.

Action of Amides upon $CSCl_4$ and $CSCl_2$.—B. Rathke.—Also unsuitable for abstraction.

Transformation of Nitric Compounds into Sulfon Acids.—B. Rathke.—On the prolonged digestion of nitroformendisulphon potassium, $CH(NO_2)(SO_3K)_2$, in the water-bath the quantity of the salt decreases, and a salt is obtained which does not contain the nitro group. This new salt has the composition of formentrisulphon potassium, $CH(SO_3K)_3+H_2O$.

Researches on the Allyl Group; on β-Bibromopropionic Acid.—G. Münder and B. Tollens.—A long and exhaustive paper not adapted for abstraction.

Transformation of β-Bibrompropionic Acid into Acrylic Acid.—W. Caspary and B. Tollens.—The authors have prepared and examined the acrylates of silver, lime, strontia, and acrylic methyl-, ethyl-, and allyl-ethers.

Constitution of the Allyl- and Acryl-Derivatives.—B. Tollens.—A lengthy theoretical paper.

On Articles of Diet in General, and on the Value of Liebig's Extract of Meat as a Constituent of Human Food.—Max von Pettenkofer.—An important communication, to which we shall return on a future occasion.

Dry Distillation of Formiate of Lime.—A. Lieben and E. Paterno.—The principal product obtained is methylic alcohol.

On Paralactic Acid, the Optically-Active Lactic Acid of Flesh.—J. Wislicenus.—A valuable and exhaustive paper.

Supplement to Researches on Certain New Derivatives of Sulpho-Carbaminic Acid.—MM. Hlasiwetz and Kachler.—The authors find that their results had been anticipated by Zeise as far back as 1842.

Spontaneous Combustion of Hay.—H. Ranke.—The author finds that, in consequence of prolonged fermentation, hay can become transformed into a true coal, which, when exposed to the air at somewhat elevated temperatures, acts as a pyrophorus.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 247, July, 1873.

Note on Rich and Pure Ores of Iron found in France.—M. Gruner.—The author points out various localities in France where brown hæmatite, manganiferous spathic iron, oligistic iron ore, and pure magnetic oxide are found in quantity.

Granier's Apparatus for Testing the Inflammability of Petroleum Oils destined for Lighting Purposes.—Report by V. de Luynes.—A small cylindrical receiver, of metal, is closed by a movable lid, provided with a circular aperture in its centre. This receiver is filled to two-thirds its volume of the oil to be tested, so that there remains between the lid and the surface of the oil a space full of air, with which the inflammable vapours furnished by the oil may mingle. A tube, soldered to the bottom of the receiver, holds a wick, whose upper extremity is in the middle of the aperture in the lid, whilst a thermometer plunged in the oil gives its temperature. To make a test, the oil is poured into the receiver to the height required; the wick is saturated with it, and lighted. The oil of the wick, burning, heats the oil till the temperature is reached, when inflammable vapours are given off. A slight explosion then ensues; the wick is extinguished, and the degree on the thermometer is read off. Petroleum-oils sold for lighting purposes in France are required to be colourless, to weigh 800 grms. per litre, and not to inflame at temperatures below 35°.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

An improved clinical thermometer. Henry Joseph François Hubert Foveaux, surgical instrument maker, 62, Strand, Middlesex. November 29, 1872.—No. 3591. This invention consists in making clinical thermometers with one or more flat sides, or placing projections thereon, to keep them from rolling upon any smooth or inclined surface upon which they may be placed, and thereby being broken. The construction preferred is a single flat surface to form the back, the front being semicircular or of any curve, this make combining with the security from rolling, due to the flat surface, the advantage of making the index appear more prominent.

Improvements in magnetic therapeutic plasters. Philip William Seymour, Surrey Lane, Battersea, Surrey. November 29, 1872.—No. 3600. The invention consists in forming a therapeutic plaster of a composition of iron-filings and any suitable adhesive matter spread upon a woven fabric, said iron-filings being afterwards magnetised.

A new and improved method of and apparatus for staining or dyeing velvets and all other woven fabrics, and for producing designs and figures thereon. John Carter Ramsden, manufacturer, Smith House, Lightcliffe, Halifax, and James Marsland Tankard, worsted-spinner, Bowling Hall, Bradford. November 30, 1872.—No. 3616. We utilise and apply, for the purpose of staining or dyeing pile fabrics or other similar goods, the different gases and vapours which arise from the slow combustion, decomposition, or distillation of the organic products of ligneous origin, or any other combustible from which the different hydrocarbon gases and volatile productions can be evolved. The gases and vapours are caused to pass into a receiver, within which condensation takes place, and a coloured deposit will be found upon the fabric placed therein. For producing patterns stencil plates or some similarly contrived patterns are laid upon the fabric, in which case the whole of the fabric will be coloured except where the patterns are. This method is applicable to other than pile fabrics.

New and improved methods or processes of and apparatus for staining or dyeing fibrous filaments when in the raw or when in a partly prepared state. John Carter Ramsden, manufacturer, Smith House, Lightcliffe, Halifax, and James Marsland Tankard, worsted-spinner, Bowling Hall, Bradford. December 2, 1872.—No. 3620. The said fibrous filaments are first saturated either wholly or in part by some chemical solution, say of acetate of lead, dissolved in water, and are then placed in an air-tight chamber, and are acted upon by the gases and vapours arising from the slow combustion, decomposition, or distillation of the organic products of ligneous origin, or any other combustible from which the different hydrocarbon gases can be evolved after the manner described by us in a provisional specification filed in the Great Seal Patent Office on the 30th day of November, 1872. In some cases it will be found advisable to dispense altogether with the use of the said gases and vapours and the same receivers, and use as an equivalent bisulphide of carbon.

The preparation of an extract from the berries of the mountain ash (pyrus) (German, *Eberesche*). Christian von Hennings, Hamburg. December 2, 1872.—No. 3628. The object of this invention is to prepare an extract from the berries of the mountain ash, suitable more especially for being used in cases of colds and influenzas.

Improvements in the mode of and apparatus for preparing lime for the treatment of sewage. Major-General Henry Young Darracott Scott, C.B., and Thomas Walker Scott, Ealing, Middlesex. December 4, 1872.—No. 3670. The main object of our invention is to economise labour when treating sewage with lime for the purpose of defecation and utilisation. Tanks or vessels are used with stirring apparatus with horizontal or inclined arms, from which are suspended metal baskets or perforated boxes containing the lump lime.

A new apparatus for distilling, concentrating, and evaporating. Farnham Maxwell Lyte, chemist, of the firm of Storck and Co., Asnières, France. (A communication from Henri Storck, Edouard Hentsch, Auguste Hentsch, André Lutscher, and Fréderic Grininger, constituting the firm of Storck and Co., and Armand Decottegnie, manufacturer, Asnières, France). December 5, 1872.—No. 3685. The features of novelty of this invention consist essentially in distilling, evaporating, and concentrating liquids in improved apparatus, the principle of which consists in a mode of heating (under increased or diminished pressure, or *in vacuo*) certain cylindrical, conical, or rounded surfaces, and bringing the liquid to be treated into contact with those surfaces in thin streams or films, so that the liquids in passing over a large extent of heating surface may be rapidly distilled, evaporated, or concentrated. The heating surface is divided exteriorly into compartments, which retain the liquid in contact therewith until evaporation is completed.

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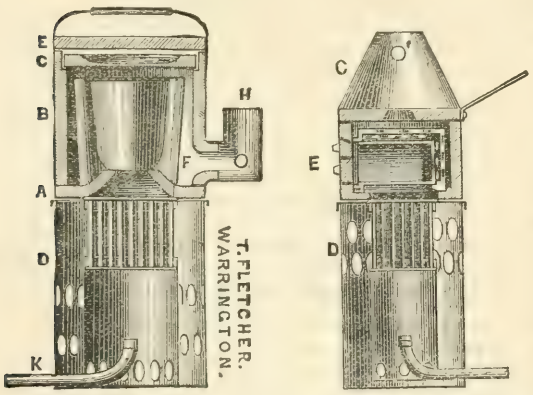

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THE CHEMICAL NEWS.

VOL. XXVIII. No. 711.

ON A

CURIOUS REACTION OF BENZOIC, SALICYLIC, AND HIPPURIC ACIDS.

By T. L. PHIPSON, Ph.D., F.C.S.

WHEN benzoic acid and glucose, in the proportions of about 3 equivs. of the former to 1 equiv. of the latter, are mixed with a large excess of monohydrated sulphuric acid, and the mixture is slightly warmed, a fine blood-red colour is developed, very similar to that produced when salicin or willow-bark are touched with concentrated sulphuric acid. After a while the mixture becomes brown, and then blackens. Benzoic acid alone does not produce this reaction. It matters little whether the glucose is artificial or natural.

Salicylic acid, with glucose, treated in the same manner, presents the same reaction in a still more decided manner.

Hippuric acid, with glucose and sulphuric acid, gives first a clear brown mixture, in which also the blood-red colour soon developes itself; then the whole mass becomes black, and evolves a large quantity of an odourless and colourless gas. This gas is not absorbed by water nor by potash, and is inflammable, burning with a blue flame: I conclude that it is chiefly oxide of carbon. As the reaction continues from this time, after the source of heat is withdrawn, the mixture soon becomes very hot, and then sulphurous acid is given off also.

PRELIMINARY NOTE ON THE REDUCTION OF SULPHURIC ACID BY HYDROGEN.

By G. J. WARNER, F.C.S.

FOR several years past I have used a method to avoid percussive ebullition in distillation, which I have found very satisfactory, viz., that of passing through the liquid in the retort a slow current of some inert gas which is easy of preparation. Dry air, carbonic acid, and hydrogen are those most generally applicable.

I had frequently distilled sulphuric acid in a current of air which had been previously dried over calcium chloride, but on using hydrogen I find that a large quantity of sulphurous acid is always evolved.

This reaction appears to commence at about 160° C., and the quantity of sulphurous acid formed increases with the temperature, but at no point was the decomposition complete. At temperatures near the boiling-point sulphuric acid always distilled over unchanged.

Fearing that the reduction might arise from the presence of hydrogen sulphide in the hydrogen, produced by sulphurous acid in the acid used for its preparation, I passed the gas first through a solution of lead acetate, and then over calcium chloride, when the same reaction ensued, although the lead solution was not blackened. Every precaution was taken to avoid the contact of cork or india-rubber with the acid vapour, the hydrogen being passed through a glass tube ground into the neck of the retort.

In some measure to confirm this reaction, I heated (1) redistilled sulphuric acid in an atmosphere of hydrogen, in a sealed tube, for twelve hours, at a temperature of 205° C.: when broken, a quantity of sulphurous acid was found in the tube in the gaseous state. (2). Two similar tubes, containing the same acid in air, heated at the same time to 205° C., contained, when opened, no sulphurous acid. (3). A sealed tube, containing hydro-potassic sulphate fused and filled with hydrogen, was likewise heated to 205° C. for twelve hours: a quantity of sulphurous acid was formed. (4). Two similar tubes, containing the same salt in "air," contained no sulphurous acid. (5). With dried ferrous sulphate, similarly treated, no sulphurous acid was produced at that temperature.

I intend to pursue this subject further, and to investigate the effect of *nascent* hydrogen on sulphuric acid of various densities, at the temperatures of their boiling-points.

This will, I expect, afford an explanation of the fact that sulphuric acid, even containing a considerable proportion of water, yields, when heated to the boiling-point with zinc, not hydrogen, but sulphurous acid.

NOTE ON THE NESSLER TEST.

By J. ALFRED WANKLYN.

IN the course of the various controversies relating to the water process frequent mention has been made of the time required for the development of the Nessler colour. According to some experimenters, a few minutes suffice for the full colouration; according to others, half an hour or more is necessary.

These differences have their origin in differences in the quality of the Nessler reagent. I have known two Nessler reagents which, although in the course of hours giving the same depths of colour with the same quantity of ammonia, required very different times for the production of the colouration. One sample of Nessler reagent gives its maximum of colour almost immediately, and another sample takes a quarter of an hour or an hour for full development.

To a great extent, these differences depend upon whether or not a sufficient quantity of solution of corrosive sublimate has been added to the finished Nessler reagents Whether the *Nesslerising* takes a couple of minutes, or whether it takes an hour, is a matter of vital importance to those persons who are working the ammonia process of water analysis; and since the employment of the ammonia process has become almost universal, I have deemed it to be worth while to direct attention to the necessity of a careful preparation of the Nessler reagent. I have, moreover, made arrangements with Messrs. Townson and Mercer for the supply of *quick* Nessler reagent at the rate of twenty shillings per litre. Those chemist. who do not feel disposed to take the trouble of making the reagent themselves have now the opportunity of buying it

NOTES ON THE

ANALYSIS OF ANIMAL CHARCOAL.

By JAMES M. MILNE, Ph.D.

Two papers on the above subject have recently appeared in the CHEMICAL NEWS, viz., one by Mr. T. L. Paterson (vol. xxvii., p. 111), and a short review of the same by Mr. A. S. Wilson (vol. xxvii., p. 225). A somewhat lengthy discussion on the same subject has also been carried on, in the pages of the "Greenock Sugar Trade Review," between Mr. Paterson and Mr. Murphy, of Liverpool, the practical results of which seem somewhat small when compared with the amount of noise made. Some of the statements made are, to say the least of it, rather novel; but it is a pity that a scientific discussion should be allowed to degenerate into mere personal wrangling, not to speak of doggerel rhymes.

With the view of satisfying myself as to the accuracy of some of the points in dispute, I have recently made a considerable number of experiments. These have been more especially directed to the determination of the moisture in samples of new char, and the presence of organic matter soluble in water.

In one of his replies to Mr. Paterson, Mr. Murphy makes the somewhat startling announcement that water with which new char has been treated is *strongly alkaline, and will therefore dissolve appreciable quantities of organic matter from a paper filter*. He thus accounts for the soluble organic matter found by Mr. Paterson in his experiments. I must confess that I, for one, have yet to learn that the water from new char is *strongly alkaline*, much more that it will dissolve filter-paper. In order to set aside all doubt on the subject, however, the following experiment was made:—5 grms. of a sample of new char were treated with water, and the liquid filtered without the use of paper, the neck of the funnel being stopped with recently ignited asbestos. The filtrate, which was quite colourless, and only very feebly alkaline, was carefully evaporated to dryness in a weighed platinum basin; the residue dried at 130° C., weighed, and cautiously ignited. The contents of the basin blackened quite perceptibly; and on the ignition being completed, and the capsule weighed, the loss was found to be 0·112 per cent —a result corresponding very closely with that given by Mr. Paterson in his paper.

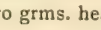
Although the moisture in samples of old or used char can be correctly determined at 212° F., it is well known that this temperature is quite inadequate for the expulsion of the *whole* of the water from new char. In his instructions for the analysis of bone-black, Fresenius gives 160° C., to 180° C. (320° F. to 356° F.) as the temperature at which the moisture should be estimated. A few years ago Dr. Wallace, in a paper on "Animal Charcoal," gave it as his opinion that a temperature of not less than 350° F. was necessary. Mr. Paterson, however, considers 350° F. much too high, and sufficient to destroy a portion of the organic matter. He considers that five hours in the water-bath at 212° F. is all that is necessary, and asserts that char, during the process of pounding, always loses water. Now, while it is quite possible that long-continued grinding in a warm atmosphere may have that effect, it is difficult to understand how a porous substance like charcoal, which retains water somewhat persistently, should lose some of it, during the short time necessary for reducing it to powder. On the contrary, we should rather expect a slight increase. That this is really the case, the results of Mr. Wilson's experiments, as well as my own, seem to demonstrate. The following experiments were made with reference to this part of the subject:—

A.—(1). A sample of new char was taken, and one-half reduced to powder; both were placed in tightly-corked bottles: 2 grms. of each were weighed out and kept in the water-bath, under precisely similar conditions. The loss of weight was as follows:—

	Unground.	Ground.
After 1 hour ..	4·67 per cent.	4·92 per cent.
,, 3 hours..	4·85 ,,	5·09 ,,
,, 5 ,,	there was no further loss in either case.	

(2). 1·2802 grms. of the same sample was heated in an ordinary air-bath, at different temperatures, as under:—

	Unground.
At 350° F. for 15 minutes the loss was	6·11 per cent.
,, 400° ,, 10 m. longer ,,	6·78 ,,
,, 450° ,, 10 ,, ,,	6·86 ,,
,, 500° ,, 10 ,, ,,	7·36 ,,

(3). 2 grms. of the sample were placed in a platinum-boat, and introduced into a glass tube about 9 inches long. The tube was then placed in an air-bath, made for the purpose, and one end attached to an apparatus for drying the air previous to entering the tube. To the other end a weighed chloride of calcium tube was attached, and this again was placed in communication with one arm of a Staedler's aspirator, by means of which a uniform and well-regulated current of dry air could always be obtained. The air-bath was heated by a small Bunsen, the temperature being registered by a thermometer passed through the lid. For temperatures not over 350° F. a glass tube of this form  is useful, the thermometer being passed through a cork, but for higher temperatures a plain tube is to be preferred.

A great number of experiments were made with this apparatus, in order to determine the water by direct weighing, some of the results of which are given below.

Two grms. heated in the air-current—

	Unground.	Ground.
At 350° F. for 15 minutes gave	6·50 per cent.	6·52 per cent.
,, 450° ,, 10 m. longer ,,	7·01 ,,	7·07 ,,
,, 500° ,, 10 ,, ,,	7·17 ,,	7·19 ,,

B.—(1). Another sample of new char (foreign) was subjected to the same mode of treatment.

Two grms. of the unground sample placed in the water-bath lost—

In 1 hour	3·23 per cent.
,, 2 hours	3·29 ,,
,, 4 ,, ...	3·31 ,,
,, 5 ,, ...	3·38 ,,

After 5 hours there was no further loss.

(2). The same quantity was placed in the air-bath.

At 250° F. for 15 minutes the loss was	3·92 per cent.
,, 350° ,, 30 ,, ,,	4·51 ,,
,, 450° ,, 30 ,, ,,	5·01 ,,
,, 500° ,, 30 ,, ,,	5·22 ,,

	Per cent.
2 grms. heated directly to 500° F. for 20 minutes lost	5·43
2 ,, ,, 500° ,, 20 ,, ,,	5·08
2 ,, ,, 500° ,, 10 m. longer ,,	5·28

(3). Two grms. treated in air-current—

At 250° F. for 15 minutes gave 4·17 per cent.
,, 350° ,, 15 m. longer ,, 4·62 ,,
,, 525° ,, 5 ,, ,, 5·32 ,,

Two grms.—

At 350° F. for 15 minutes gave 4·61 per cent.
,, 450° ,, 10 m. longer ,, 4·81 ,,
,, 500° ,, 5 ,, ,, 4·92 ,,

Two grms.—

At 450° F. for 30 minutes gave 5·03 per cent.

Two grms.—

At 450° F. for 20 minutes gave 5·24 per cent.
,, 500° ,, 15 m. longer ,, 5·29 ,,

Two grms. were taken as before, but in this case the *loss* of weight was also found by weighing the residue in the boat, which was placed in a closed tube.

	Gain in $CaCl_2$ Tube.	Loss from Residue.
At 500° F. for 10 min.	5·40 per cent.	6·63 per cent.
,, 500° ,, 15 ,,	5·47 ,,	—
,, 500° ,, 20 ,,	5·55 ,,	6·98 ,,
,, 525° ,, 5 m. longer	5·65 ,,	7·22 ,,

Two grms.—

At 500° F. for 20 min.	5·35 ,,	6·03 ,,
,, 500° ,, 30 ,,	5·37 ,,	6·21 ,,

From an examination of the above results we are justified in concluding—

1. That the water in a sample of new char is sensibly *increased* by the process of pounding, instead of being diminished.
2. That a temperature of 212° F. is quite inadequate for the determination of the water in such samples.
3. That there is a *loss* on heating in the air-bath up to 500° F., and that, if heated in the air-current, there is a *gain* in the $CaCl_2$ tube up to that temperature, showing that even at 350° F. the water is not *completely* expelled.

The determination of the water by *direct* weighing is, of course, to be preferred to the ordinary air-bath, which at the higher temperatures usually gives too high results. The difference between the gain in the $CaCl_2$ tube and the loss from the residual char shows that the loss of weight is not entirely water. I would recommend heating in the air-current for, say, 30 minutes, as giving reliable results.

Chemical Laboratory,
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ON THE ACTION OF WATER ON LEAD.

By Sir ROBERT CHRISTISON, Bart.

THE most general results of the author's former inquiries are—1. That the purest waters act the most powerfully on lead, corroding it, and forming a carbonate of peculiar and uniform composition. 2. That all salts impede this action, and may prevent it altogether, some of them when in extremely minute proportions. 3. That the proportion of each salt required to prevent action is nearly in the inverse ratio of the solubility of the compound which its acid forms with the oxide of lead.

The effect of certain inorganic and organic ingredients of water in modifying the preservative power of the salts the author did not investigate. This has been made the subject of numerous inquiries and observations by others, chiefly, however, of a desultory nature, some of them much too succinctly described, and some, also, of questionable accuracy.

It has been denied that water acts by reason and in the ratio of its purity; and it has even been alleged that distilled water itself does not act if really quite pure. The author has, however, invariably found the reverse to be the case, and can assign no other explanation of these statements, except some error in manipulation. For example, a very pure spring water was sent to him from the south of England, with the assurance that it had been found incapable of attacking lead; but, on making trial of it, he found it to act with an energy not inferior to that of distilled water.

It has also been stated that ordinary distilled water is apt to contain a trace of nitric or nitrous acid, from nitrates incidentally present in the water subjected to distillation; and that such water, if distilled after the addition of a little potash to fix the acid thoroughly, yields a distillate which has no action upon lead. But when the author prepared distilled water in this way, with great care to prevent the access of impurities from other sources, the only result was that the action was even stronger than that of the ordinary distilled water of the laboratory, and greater, indeed, than he had ever before observed.

An interesting statement has been made by Dr. Nevins, to the effect that some salts appear to allow of a certain action going on when they are present in water largely, although their influence when they exist in very small quantities is to act as preventives. This result the author has sometimes obtained, and has found the action such as might prove dangerous. But its limit requires to be defined; and there is reason to suppose that the proportion required to *permit* action will be found to be greater than is ever likely to occur in the instance of waters applicable to household use.

It has also been said, but in general terms and without experimental proof, that the presence of carbonate of soda, even in a hard water, takes away the preventive influence of the other salts, and enables the water to dissolve lead. There appears to be some foundation for this statement; but here, too, it is necessary to fix what is the limit to such influence before its importance can be valued. Moreover, as bicarbonate of soda appears to have no such effect, and this is the usual form of the carbonate in natural waters, the practical importance of the fact is inconsiderable.

The corrosive action of water upon lead has often been confounded with other causes of corrosion, and the water has borne the blame. Thus the true action has been confounded with the corrosive action of potent agents accidentally coming in contact with the metal in the presence of water, as, for example, when a lead pipe has been led through fresh mortar, which is frequently or permanently kept moist, or when lumps of fresh mortar have been allowed to fall upon the bottom of a lead cistern.

The true or simple action of water has not unfrequently been confounded also with the effects of galvanic action. Thus, if a lead pipe or cistern be soldered with pewter solder and not with lead, erosion takes place near the line of junction of the solder with the lead. The presence of bars of other metals crossing lead, or bits of them lying on it, will also develop the same action; and some facts seem to point to the same property being possessed in a minor degree by some stony and earthy substances. This observation may explain the local erosion sometimes observed in cisterns containing hard water; since, if galvanic action be excited, it will be increased by the fact of saline matter existing more largely in these waters than in soft or comparatively pure water.

Lastly, some observers have contradicted former statements, because under certain circumstances, which led them to anticipate no action, they nevertheless found lead in water, but only in extremely minute and unimportant proportion. The test for lead, hydrosulphuric acid, when employed in the way now usually practised is so delicate as to detect that metal when dissolved in ten million parts of water, or even more. Facts, however, warrant the conclusion that the impregnation must amount to at least ten times this quantity before water can act injuriously on man, however long it may be used.—*Iron.*

ON THE ENERGIES OF THE IMPONDERABLES,

WITH ESPECIAL REFERENCE TO THE

MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from p. 7).

MEN need but watch the progress of science-truths for a few years, or read the development, stage by stage, of any branch of investigation, to be satisfied of this, that, with whatever pertinacity and show of reasoning any theory is propounded and established, it rapidly wanes. Astronomical and geological truths and facts, how often and again have they been satisfactorily (?) explained, and yet how soon and how rapidly has one explanation been so crushed out by another, that the first, which by its authors was applauded, is by the upholders of the second ridiculed.

The theories of the imponderables, with which we must occasionally deal or allude to, but with which we are in no degree further concerned, are, day by day, in a transition state. Like the cause of solar heat, or the rotation of the moon, they are a bloodless battle-field, on which, with our increasing love of talking and our decreasing love of working, words may war with words.

A triumphant victory to-day in science theory may be the prelude to an ignominious defeat of the same theory to-morrow. Subject, doubtless, to many dissentient views, the belief that he who propounds theory, and uses theories solely as means or ways by which to convey ideas of how such and such facts may perhaps be brought about, and not as expressing a conviction that the way described is the actual plan in operation, he is the truly wise man. Those who allow themselves to dwell upon the conception

* The Cantor Lectures, delivered before the Society of Arts.

and the development of theories, who build theory upon theory, who sometimes pile Ossa upon Pelion, and sometimes Pelion upon Ossa, are not unlike those whom Milton describes—

. . . . "Who reasoned high
Of providence, foreknowledge, will, and fate,
Fixed fate, free will, foreknowledge absolute,
And found no end, in wandering mazes lost."

Thus it is that the decisions of one age and one day differ from those of another age and another day. Theories, we must remember, are but opinions; with opinions, as such, this course of lectures is not concerned. The facts of Nature, so far as they have yet been made apparent, or may be in process of being so, are our province. They change not. To those who have appealed to Nature direct, and brought from her exhaustless stores of knowledge some truths that men may utilise, is due the information which is to be brought before you.

The mode by which they have won this knowledge is exactly that pursued in our courts of law and equity, to arrive at the truth on one point, and on one point only. Look how long and tedious legal investigations seem, and yet in how few words the result is declared. Guilty or not guilty—Verdict for the plaintiff or verdict for the defendant. One or other of these very brief phrases records the conclusion or the judgment of many days of patient labours and searchings for truths.

To not less careful questioning by men in years past, as well as now current, we owe all we know of the energies, the measurement and utilisation of which is to be a feature in these lectures. That cross-questioning of the keenest and clearest kind has been essential may be inferred from the fact that these energies are so co-related—so mutually convertible—that they merge and change, Protean-like, one into the other so instaneously that no one energy can be conveniently retained alone and in operation. They thus pass and interchange without (to our eyes) a signal from any magician's wand.

The transmutations of the imponderables are accomplished in a way that would have gladdened the eyes of the most profound alchemist, could he have seen as great transmutations in some of the material things in which he worked. For example, whenever energy is lost by resistance, heat is produced, *i.e.*, when the resistance is perfect and complete, admitting of no intermediate state; *e.g.*, if a wheel in machinery does not move easily, the consequence is heat, manifested on the shaft.

If, however, that energy can be converted into an intermediate state, then this state may be assumed—much as light from gas is an intermediate state between chemical affinity and heat. Do what we may, that from which energy results can neither be created nor destroyed.

In the case of blows by impact, as in the tongue of a bell, or the hammer on an anvil, or a clock, or a piano, or on a drum-head, or on a gong, then, whilst doubtless some part of this checked energy is converted into heat, yet a large portion is spent in the production of vibrations in matter, appreciable to our senses, and suggestive of vibrations in molecules, which our senses, aided by physical appliances, have not yet made visible, but which chemical changes, and what to the minds of science theorists of the present day is conclusive evidence, seem to point as similar vibrations in the invisible molecules and atoms of which it is assumed that bodies consist.

These remarks may suffice to explain that whilst to speak of estimating an "energy" is easy, yet to estimate that "energy" is an employment which tasks the keenest and most watchful faculties of the human mind, as well as claiming from human hands the production of some of their most exquisite and refined work.

The difficulty of the task results not so much from a solution of the simple problem which the words "estimate that energy" convey, as from the incompetence alluded to of isolating and continuing the special energy and noting its operation. For no one of nature's energies, be they ponderable or imponderable, is alone. Solitariness in the unseen, as well as in the seen, is no part of nature's plans.

Faraday seemed to have realised this view in great intensity when he wrote—"If, as I believe, dualities are essential to the forces, are always equal, are mutually dependent, that one cannot appear or exist without the other: the proof of this would lead to many consequences of high importance to the philosophy of force generally."*

This interlacing of energies,—this co-relation, as it is called, of physical forces,—whilst it knits in harmonious union energies which are nominally distinct, baffles the investigator who wishes to assign to each its share in any specific work. For example, the energy of gravity operates everywhere, and our fundamental principle in hydraulics, that fluids press equally in all directions, may be granted as a postulate. The experiments by which it can be confirmed may be and is very clearly described, but no one has ever made or can make them. Gravity never ceases to impress upon fluids a downward tendency, and so prevents an equality of pressures in all directions being established.

It may be in the interest of the Moslem faith to assert that, without visible means, Mahomet's coffin rests between earth and heaven; but, assuming the truth of the tradition, or of the fact (whichever it be), we know well that gravity operates in all its wonted intensity, and that the coffin is held there (if held at all) by the introduction of some counteracting energy, as that of magnetism.

The energy of electricity is ever passing into heat—that of heat into electricity or light. Electricity, again, appears to assume the form of vitality; and then, again, it totally fails to fulfil the vital conditions. In some animals the exhaustion of their muscular energy is consequent upon the exhaustion of their vital energy, and no electrical appliance can restore the vital energy, even though it seems to restore the muscular. Take affinity. This passes, by means unknown to us, into electricity and heat.

There is also this peculiarity amongst these energies. The work of one energy, estimated by any means known to us, gives no indication of the work of some other energy, resident or potential, in the same matter.

For example, the estimation of a drop of water by gravity standards—to speak of it as weighing so many grains—gives no indication whatever of its ability to promote affinities, to absorb and convey heat, to decompose light. And if even all these were known, there would still be no indication that upon an electrical standard of measurement its destructive effects are equal to that of a flash of lightning.

The only energies that may be said to be non-interchangeable are those of gravity and vitality. The former is enduring, the latter fleeting. The character of the one is persistence and constancy; that of the other, change and variety. Gravity may be said to be quietly resident in matter; vitality shows its presence by growth or motion.

Gravity is an energy pervading all nature, as intense in grains of sand as in the mountain; in a drop of water as in the river or the ocean. Disregarding alike the vitality of the plant or the animal—for gravity treats them as though they were as inert, indifferent, and unconscious of its presence as the soil of the garden, or the mineral under the earth—thus this energy, which is to occupy our chief consideration in the next lecture, is alone, and yet we shall find how that it has been left for recent times to tabulate its measure, to report and utilise, under the guidance of ordinary arithmetical and mathematical rules, the scientific and social consequences of the measure so established.

The other energy, that of vitality, which is to occupy

* *Proc. Roy. Inst.* for 1854, 6.

our attention in a future lecture, can hardly as yet be said to have been measured. The time, however, is very near when the hope will be realised; that the energy of vitality—the mechanical, the statical, dynamical, and absolute energy, of course, is meant—may be reduced to as exact a science as those of light, heat, and electricity have recently been.

All who have questioned Nature are well aware how simply and truthfully she replies. It must, however, be steadily borne in mind that this truthfulness applies to the question and answer in their mutual relations. If the question be so put that Dame Nature has to answer in respect to the combination of two elements, and so is called upon to give a reply which is in truth the aggregate of the two, she does so. It behoves the questioner to frame his question with the utmost care, in order to eliminate what is extraneous to his purpose. All must have observed how difficult it is to frame a question which cannot be mis-read, or admit of a reply evidently based upon a view which the questioner never contemplated. For example, if the question relates to gravity, caution is needed to exclude the buoyancy and even viscosity of the air, and the centrifugal effects of the earth's rotation.

If it relate to electricity, caution is needed to exclude the most infinitesimal alloy of a metal—even a metal itself.

If it relate to vitality, caution is needed to exclude the effects of temporary exhilaration or prostration.

If it relate to affinity, caution is needed to exclude the complication of phenomena by variations in gaseous pressure or atmospheric temperature.

If it relate to heat, caution is needed to exclude peculiarly constituted substances, in their unknown and varying effects on heat from their atomic or rather molecular condition.

Although, for purposes of classification and the general distinction of the phenomena, the energies found in nature are arranged under the general energies which are prefixed to the respective lectures of this course, yet it must be borne in mind that these are verbal rather than emphatically actual distinctions. They are merely the terms recognised at the present day, and in a few years may be dismissed. The convertibility of energy just now alluded to is a phrase which conveys a clear meaning, but this convertibility is a process that cannot be followed. At one time in the science world a general principle seems to have been established in relation to it; again and again the hope fades, the principle is on no secure basis, whilst the convertibility is ever active. It may not inappropriately be asked which energy is the source of the others—which, in fact, seems to have the highest claim to be classed as *the one*. Doubtless, as a question of sequence, in time gravity must claim the first place, but, so far as our powers of utilising the energies of the imponderables are concerned, we are not able to appeal very hopefully to gravity. We cannot obtain the other energies from it. Gravity refuses to be converted; its political principles are of the type which permits no change. Nature's No. 1 must be gravity; man's No. 1 affinity. For example, oxygen and hydrogen manifest their affinities in obedience to some inexplicable law. They enter into what is called combination, and in so doing manifest one form of energy to which the name of the "energy of affinity" is given. But in the transition state—in the act of obeying the very imperfectly known laws of affinity—another energy of a different name and character appears, viz., heat. Evidence of the power of this energy—heat—is furnished to tests very different to those which may be applied to the energy of affinity. The heat is presented to the thermo-electric pile, and that a great change in the mode of its energy has taken place is obvious from the results it produces at a distance; to this new form of energy we give the name of electricity. By a species of magic, electricity has called forth an energy to which is given the name of magnetism. Suitable circumstances being presented to this new energy, there is a machine propelled and capable of doing mechanical work. We now call it mechanical energy.

Thus, by change superposed on change, the energy of an imponderable has been converted into that energy of the ponderable to which we are indebted for all, or nearly all, of arts, manufactures, and commerce.

The two imponderable energies into which chemical affinity cannot be converted are vitality and gravity. These two may, as we shall hereafter find, assume the form of the others—the others cannot assume their forms—at least not in any plain and honest sense. Except in these two physical energy is a visible reproduction of the invisible doings of chemical affinity.

Simple as this process of transformation may appear, and convenient and useful as the suddenness of the change may be, it cannot be denied that to the investigator it is perplexing. Men, however, labour on, each perhaps winning a little from the unknown, and adding it to the known. Thus, although "hills peep o'er hills, and Alps on Alps arise," yet men of varied resources and patient perseverance have won those invaluable treasures of measurement and utilisation from the imponderables and unseen which give the title to this course of Cantor Lectures.

Even Livingstone has not shown a more noble resolve "to conquer or to die" than have those to whom we are indebted for all we know touching the modes of measuring the energies of gravity, vitality, affinity, electricity, light, and heat.

As illustrations of the difficulties of the tasks before them, it may suffice, in this introductory stage, briefly to observe that:—

Galvanic currents may escape notice unless the intensity of terrestrial magnetism be neutralised.

Diamagnetism and the magneto-electric spark escape notice, unless a large number of galvanic cells or their equivalent is used.

What was called the "smell of electricity" led Schonbein to the discovery of "ozone," a remarkable product, and one whose energies are yet unknown, although being slowly but surely developed.

That a vibrating magnetising needle came to rest sooner in the neighbourhood of a copper plate, now called a damper, then when the plate was away, led to the discovery of the induction of electric currents by Faraday.

Opinions from telescopic appearances of the size of the stars led to an idea that their discs differed; the phenomenon has been found to be due to the diffraction of light.

The velocity of sound was calculated, making due allowance for the direction of the wind; in recent years it has been found that the heat developed by one particle of air striking another, must be taken into account.

(To be continued.

Royal School of Mines.—At a meeting of the Council, held on Saturday, July 5, the following gentlemen received the diploma of Associate of the Royal School of Mines:—Mining and Metallurgical Division—E. Jackson J. A. Griffiths, C. Law. Mining Division—A. G. Phillips. Metallurgical Division—J. W. Westmoreland, S. W. Davies, J. C. Jefferson, H. S. Bell. Geological Division—G. Smith. The following scholarships and prizes were awarded:—The two Royal scholarships of £15 each, for first year's students, to Mr. W. Carter and Mr. A. J. Meeze. For second year's students—His Royal Highness the Duke of Cornwall's scholarship of £30 for two years, to Mr. C. Lloyd Morgan; and the Royal scholarship of £25, to Mr. S. A. Hill. The Edward Forbes medal and prize of books, for natural history, to Mr. G. Smith. The De la Beche medal and prize of books, for mining, to Mr. Edgar Jackson. The Murchison medal and prize of books, for geology, to Mr. C. Lloyd Morgan.

CORRESPONDENCE.

ON A SYSTEMATIC MINERALOGICAL NOMENCLATURE.

To the Editor of the Chemical News.

SIR,—As I see by your report last week of the meeting of the Chemical Society that Mr. Hannay has called attention to a new system of mineralogical nomenclature, I sincerely hope that this most important subject will not be allowed to fall to the ground until something has been done. No person will deny that the state of hopeless confusion into which the method of naming minerals has fallen is very injurious to the advance of the science, and there is nothing which would do more good to the science of mineralogy than the introduction of a real systematic method of naming the substances composing the crust of the earth. The present state of affairs makes a complete knowledge of mineralogy next to impossible, and the difficulty which beginners experience in gaining a knowledge of the properties and position of each mineral in relation to others (having no systematic name to guide them) is very great indeed. There has been an immense amount of work done in mineralogy, both in the chemical and physical constitution of the minerals; and this great body of work just requires one addition to bind together the scattered forces, and that addition is a systematic nomenclature. As chemists are by far the most influential body connected with this subject, I hope to see them take the matter up, and, by introducing a new system, set mineralogy on its feet.—I am, &c.,

R. W. EMERSON MCIVOR.

Glasgow, July 1, 1873.

ON BUTTER.

To the Editor of the Chemical News.

SIR,—I was much pleased to find in the CHEMICAL NEWS (vol. xxviii., p. 1) a paper "On Butter," by Dr. Brown. May I suggest to you the great benefit to myself and others if you would continue such valuable papers? The Adulteration Act now in use would justify surely such articles, and would enable chemists in the provinces to see the means used for detection of adulterations by gentlemen whose skill as analysts is above any doubt. I am not aware of any work on adulterations except Dr. Hassall's, and that I think is much too prolix as a handbook, although very excellent in its way.—I am, &c.,

J. B.

ON BUTTER.

To the Editor of the Chemical News.

SIR,—The extraordinary paper which Dr. Campbell Brown publishes in the last number of the CHEMICAL NEWS calls for a few words of comment. Dr. Brown, who is a Doctor of Science of the London University, appears not to know that butter resembles suet, tallow, dripping, and lard by containing, as they do, stearin, olein, and palmitin; and that it differs from them only by containing these fats in different proportions, and by containing very small quantities of butyrin, &c.

His notion of looking for the milk globules in butter is very amusing, especially when it is borne in mind that butter is frequently raised to its melting-point either by accident or by design, and, according to good authority, is none the worse for the process.

The analytical operations which he recommends for the purpose of detecting adulteration of butter with foreign fats appear to me to be utterly delusive; they are on a par with the chemistry of the composition of butter.

Inasmuch as Dr. Brown occupies a responsible position, being Public Analyst for Liverpool, Cheshire, and the Isle of Man, I have felt it my duty to make this protest against his methods of procedure.—I am, &c.,

J. ALFRED WANKLYN.

London, July 5, 1873.

NOTICES OF BOOKS.

Notes of a Course of Nineteen Lectures on Natural Philosophy. Delivered at Guy's Hospital during the session 1872-3. By G. F. RODWELL, F.R.A.S., F.C.S. London: J. and A. Churchill. 1873.

NOTES, summaries, or recapitulations are, when properly made and used, of great value to the student,—are, in fact, quite necessary if he has to pass through the ordeal of an examination. Nevertheless they are very dangerous and liable to much abuse by becoming elements of the machinery of cramming. Hence we open this book with a certain degree of suspicion, which is not diminished by the preface, wherein the omission of Acoustics and the comparatively slight treatment of Light is explained by the fact that the Lectures "had special reference to the requirements of the Preliminary Scientific (M.B.) Examination of the University of London." An abstract of lectures delivered with this avowed object necessarily treads on the frontiers of cram, and no small amount of skill is necessary to keep them from stepping across.

On further examination of Mr. Rodwell's Notes, we find that this difficulty is very skilfully mastered, and a really sound and useful abstract of the subject is given; the short propositions are by no means stated in a form that would serve to mechanically pack the memory with a series of mere answers to examiners' questions. Considering the small space into which the subjects are condensed, there is a very fair amount of logical sequence binding together the propositions, which for the most part are stated rationally rather than dogmatically. Anything like complete demonstration is, of course, impossible in the space of such notes, nor could it have been attempted in the full extension of merely nineteen lectures required to cover the subjects of the Statics and Dynamics of Solids, of Hydrostatics, Hydrodynamics, Pneumatics, Light, Heat, Magnetism, and Electricity. Thus limited, there was no need of the apology in the preface for subjects omitted. The apology should rather have been for the excessive quantity which the compulsory limitations of the teacher's time has forced him to include in so short a course.

This work displays a defect which is common to most of our modern elementary treatises, one which appears to be growing at a rate which threatens to seriously damage the educational value of physical science. We refer to the statement of hypotheses in such a manner that the pupil is likely to accept them as actual facts. This is especially displayed in the summary of the subject of heat. The following is an example:—"Since all matter possesses a certain amount of molecular motion, and no two molecules are in contact; it follows that all molecules possess a certain amount of potential energy, and that the acts of heating and cooling (addition and subtraction of molecular motion), may be expressed respectively as the increasing and the lessening of molecular potential energy, considered in regard to its amount at the time of such addition or subtraction."

Here, as in other propositions, the existence of molecules, of inter-molecular spaces, and of molecular motion are described in the same positive and unqualified terms as expansion or contraction, solidity or fluidity, and there is nothing to indicate the vast difference between the actual and demonstrable facts, and the figments of philosophical imagination. Even if this conception of the discrete molecular constitution of matter were universally accepted, it would be absolutely necessary to sound intellectual

discipline that the student, at the very outset of his barest rudimentary studies, should be taught that these molecules separated by interspaces through which they swing with varying range of motion, are purely poetical conceptions to be clearly distinguished from the positive physical facts which they have been invented to explain. The use of the imagination in science, and in all other comprehensive efforts of the human mind is, perhaps, as necessary as the use of the senses and the reasoning faculties, but to escape the erection of a whole fabric of rotten fallacies we must clearly distinguish between the facts of observation, the conclusions of reasoning, and the creations of imagination.

As already intimated, these strictures are not applied solely or especially to the work of Mr. Rodwell, but refer to a generally growing vice of elementary works on physical science. We have thrown overboard "the imponderables," and no longer talk with flippant familiarity of electric magnetic *fluids* or of *caloric*, and therein have acted wisely, but our progress will become a mere oscillation if we erect mathematical idols on their pedestals, and worship them with equally unreasoning blindness.

Having uttered this protest, we may, for the rest, strongly recommend these Notes to all who need the intellectual refreshment of a well-arranged and carefully-written condensation of the leading facts and principles of the chief elements of Natural Philosophy.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, June 16, 1873.

Heat Liberated by the Combustion of Formic Acid.—M. Berthelot.—A thermo-chemical paper, bearing chiefly on the dispute pending between Favre and Silbermann on the one hand, and Thomsen on the other.

Alloys used for Gold Coinage.—E. Peligot.—Suggestion on a uniform international monetary standard.

Report on Investigations relating to Phylloxera vastatrix.—MM. Duclaux, Cornu, and L. Faucon.—An enquiry into the ravages of a vine-destroying insect, along with an analysis of the roots of the vine.

Researches on the Essence of Alangilan (*Unona odoratissima*).—This essence, lately introduced into the market, commands the price of 2500 francs per kilog. It is extracted by distillation from the flower of a tree found in Jamaica. The specific gravity of the essence at 0·15° is 0·980. A column of 5 c.m. in depth deflects a ray of polarised light 14° to the left. It distils over entirely between the temperatures of 160° and 300°, without leaving a carbonaceous residue behind. It is insoluble in water, partially soluble in alcohol, and entirely soluble in ether. After partial saponification with potassa it yields benzoic acid.

Contributions to the History of the Histological Constitution and the Chemical Function of the "Glairine" of Molitz.—A. Béchamp.—Glairine is a deposit obtained from the sulphur-springs of Molitz. It consists chiefly of gelatinous silica, and, like the microzymas of chalk and other calcareous formations, is capable of exciting fermentation.

Determination of the Total Nitrogen contained in Manures.—H. Pellet.—The process consists in the addition of a large excess of inert organic matter (starch), and of soda-lime, to the nitrogenous organic matters containing nitrates. A combustion-tube is taken, 70 to 80 c.m. long, the end of which is charged with oxalate of lime and a small quantity of soda-lime: 1 to 2 grms. of the substance under analysis are weighed out, and well mixed in a mortar with 8 to 10 grms. of starch, free from nitrogen, and an equal weight of pulverised soda-lime. The success of the operation depends on the care with which this mixture is made. The tube is then filled up with soda-lime, and the combustion executed in the ordinary manner. The process is not found applicable to the assay of commercial nitrates, as the error would become too great.

Determination of Phosphoric Acid in Natural Phosphates and Manures.—H. Joulie.—A reply to Mène's criticism contained in the *Comptes Rendus* of June 9th. M. Joulie remarks that the process which Mène condemns as inexact is totally distinct from the one which he recommends. He points out that Chancel's process (bismuth), as its inventor admitted, is applicable only to substances containing little alumina and oxide of iron, and free from sulphates and chlorides—a state of affairs very rare in manures, and especially in superphosphates.

Method of Determining the Hæmoglobin in Blood.—M. Quinquaud.—The maximum volumes of oxygen absorbable by a given volume of any blood are proportional to the hæmoglobin which these bloods contain. For this purpose it is needful to know the weight of hæmoglobin corresponding to 1 c.c. of oxygen, and to determine exactly the quantity of oxygen which the blood in question retains when saturated: 100 c.c. of human blood contained 260 c.c. of oxygen, ox blood contained 240, and drake's blood 170. The amount of iron contained in 1000 grms. of blood, as determined by Pelouze, is—

Man	0·53 grm.
Ox	0·48 ,,
Drake	0·34 ,,

Hence the amount of hæmoglobin in 1000 grms. of blood is in—

Man	125 grms.
Ox	120 ,,
Drake	82 ,,

The numbers given by Preyer, as found by a spectroscopic method, are higher, but their relative proportions are the same.

Determination of the Mechanical Coefficients of Food.—A. Sansom.—A mechanico-physiological paper.

Experimental Researches on the Influence which Change of Barometric Pressure Exerts on Vital Phenomena.—P. Bert.—An interesting physiological investigation.

On Aniline Greens.—MM. Lauth and Baubigny.—The authors propose to replace the iodide of methyl, in the manufacture of certain aniline colours, by an ether with a mineral acid, a sulphate, hydrochlorate, nitrate or phosphate, or by the sulpho-conjugated acids of the alcoholic radicals. The best results have been obtained with nitrate of methyl in presence of an alkali or alkaline earth. The energetic action of this ether renders it practicable to operate at low temperatures, either in open or closed vessels.

Photochemic Researches on the Use of Gases, &c.—M. Merget.

Researches on Electricity Produced by Mechanical Action.—M. Joulin.

Polytechnisches Journal von Dr. E. M. Dingler, No. 2, 1873.

On Pyrometrical Experiments.—A. Weinhold.

Remarks on the Decay of Rocks, and on the Increase of Volume accompanying Crystallisation.—F. Kuhlmann.

On an Alteration of Cast-Iron produced by the Action of a Mineral Water Rich in Sulphur.—E. Priwoznik.

Manufacture of Soda by Means of Bicarbonate of Baryta.—G. Lunge.

Processes for the Volumetric Determination of Carbonic Acid.—A. Houzeau.

Determination of the Amount of Acid in Fatty Oils.—M. Burstyn.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, June 9, 1873.

Action of Ammonia and its Derivatives upon Ketones in Presence of Dehydrating Bodies.—MM. Engler and Heine.—The authors have investigated the action of ammonia upon acetophenon, and that of aniline upon aceton, both in presence of anhydrous phosphoric acid. In the former case they obtained a base to which they give the name acetophenonin, which shows few noteworthy reactions, and forms well-defined crystalline salts with acids.

Solubility of Saline Mixtures.—F. Rüdorff.—The author examines those cases where a decomposition is possible. He finds that when ammonia is determined by boiling a solution with caustic alkali, and receiving the ammoniacal fumes in standard sulphuric acid, the alkaline liquid bumps violently on boiling, especially if metallic salts are present. This may be avoided by heating, not by direct fire, but by blowing steam into the liquid.

On Trinitro-Naphthalins.—F. Beilstein and A. Kühlberg.—The authors distinguish three trinitro-naphthalins: the modification α was obtained by d'Aguilar, on boiling α-dinitro-naphthalin (fusing at 211°) with fuming nitric acid. It crystallises from alcohol in saw-shaped leaflets, and fuses at 122°. β-trinitro-naphthalin is obtained by boiling β-dinitro-naphthalin for a few minutes with 5 parts fuming nitric acid and 5 parts strongest sulphuric acid. It is very readily soluble in alcohol, and melts at 213°. A third modification, γ-trinitro-naphthalin, is formed on treating α-dinitro-naphthalin with the above-mentioned mixture of sulphuric and nitric acids. It is precipitated with water, and re-crystallised several times from crude nitric acid. It forms splendid pale yellow leaflets. From fuming nitric acid it is deposited in brilliant four-sided tables. It melts at 147°.

Investigations on Isomerism in the Phenel Series.—H. E. Armstrong.

Natural System of the Chemical Elements.—H. Baumhauer.—The author prefers to arrange the atomic weights in the form of a spiral line on a plane surface, hydrogen being placed in the centre. He refers to his pamphlet, "The Relations between Atomic Weights and the Nature of the Chemical Elements," Brunswick, 1870. He points out that, on comparing the atomic weights with the specific gravities of the same bodies, both increase in the same direction in case of a homologous series of bodies. He traces relations of this kind in the following groups:—Sulphur, selenium, and tellurium; chlorine, bromine, and iodine; copper, silver, and mercury; magnesium, zinc, and cadmium; carbon, silicon, and tin; phosphorus, arsenic, antimony, and bismuth; glucinum and aluminium. A remarkable exception is found in the series of alkali metals,—the specific gravity of potassium being not greater, but smaller, than that of sodium.

Metallic Derivatives and Structural Formula of Cyanamid.—E. Mulder.—The author has previously shown that hydantoin is not formed of the action of alcoholic ammonia upon bromacetyl urea. Neither is hydantoin formed on heating bromacetyl urea with alcohol in a sealed tube. Glucoluril is decomposed by hydrochloric acid into hydantoin and urea. The synthesis of glucoluril, therefore, may lead to that of hydantoin. By the reaction of bromacetyl urea and cyanamid the author obtained not glucoluril, but a sparingly soluble gelatinous body. If an aqueous solution of cyanamide is added to nitrate of silver a fine yellow precipitate is formed. Cyanamide is also precipitated by an ammoniacal solution of nitrate of silver, as the yellow precipitate is sparingly soluble in ammonia. It was found to be a silver substitute of cyanamid, CN_2Ag_2. If cyanamid is CN_2H_2, it would be more correctly named carbodiimid. Its change into guanidin becomes thus intelligible. An aqueous solution of urea, made alkaline with hydrate of soda, also gives a pale yellow precipitate with nitrate of silver. Silver carbodiimid has the following properties:—It is yellow, amorphous, insoluble in water, sparingly soluble in ammonia. It dissolves in dilute nitric acid, and is re-precipitated with ammonia. If potash is added to the nitric acid solution, silver carbodiimid is formed again, and can be boiled with an excess of potash without perceptible decomposition.

Action of Perchloride of Phosphorus upon Sulphacetic Acid.—R. Siemens.

Action of Sulphuric Acid upon Substituted Anilines.—H. E. Armstrong.—The author has studied the action of sulphuric acid upon ethylanilin and dimethylanilin. He announces as in progress the examination of the sulph-acids formed from the brom- and nitraniline.

The Relations between the Velocity of the Propagation of Sound in Gases and their Molecular Weights.—C. Bender.—The author concludes that these velocities in different gases are inversely as the square root of the molecular weights. Taking the so-called "dust-figures" of Kundt, he finds that the velocity of sound in the media in question is inversely proportional to them, and the square root of the densities directly proportional.

On Oxycymol and Thiocymol.—F. Roderburg.—The author seeks to compare the oxy- and thio-derivatives obtained from cymol with those obtained directly from camphor. The experiments show that in cymol-sulphon acid, and in the oxy- and thio-cymol obtained from it, the inorganic groups occupy the same position as do the oxygen and sulphur in the oxy- and thio-cymol prepared directly from camphor.

Respiration and the Inclosed Air of Sugar Beet-Root.—Arnold Heintz.—Sunlight induces chemical transformation in chlorophyll, the vegetable assimilative organ. The substances necessary to build up the body of the plant are produced from carbonic acid and water, oxygen being eliminated. The process may be thus generally expressed:—

$$xCO_2 + xH_2O = xC(x-7)H_2O + 7H_2O + xO_2.$$

If $x=6$ and $7=1$, the result is starch. If $x=6$ and $7=0$ we obtain glycose. The chemical intervention of atmospheric nitrogen in the matters of the living plant-cell is exclusively denominated respiration, and is diametrically opposed to the assimilatory process—the absorption of carbonic acid. Dutrochet rightly compares the respiring plant with insects and other cold-blooded animals, and Sachs likens oxygen to "the spring of a watch," whose elasticity sets all the parts in motion. In the growing plant the elimination of oxygen preponderates, but when the absorption of carbonic acid is interrupted the respiratory process becomes more prominent. As early as 1779 Ingenhauss discovered that roots, flowers, and fruits give out carbonic acid. Respiration, or slow combustion, can be well observed in case of the sugar beet-root, whilst its nutrition is suspended in the winter. The roots stored up for use go on respiring, and their sugar is decomposed.

It was found that a store of 1000 cwts. of roots lost, in two months, 10 cwts. of sugar. The air contained in the roots was found to be—

	Vols.
Carbonic acid	30·52
Oxygen	0·14
Nitrogen	69·34
	100·00

Another portion yielded—

Carbonic acid	35·10
Oxygen	0·56
Nitrogen	64·31
	99·97

Revue Scientifique de la France et de l'Etranger, No. 50, June 14, 1873.

Congress of German Naturalists and Physicians. Session of 1872, at Leipzig. Chemical Section.

Michaelis described certain new compounds of phosphorus. He obtained $P_2S_3Br_4$ by acting upon bromine with trisulphide of phosphorus. By means of this body he prepared PS_2Br and $PSBr_3$, thus completing the group of the sulphobromides of phosphorus. He has also produced a compound of $PSBr_2$ with PBr_3, and one of $PSBr_3$ with H_2O.

Rathke has formed the compound $CSCl_4$ by acting upon the bisulphide of carbon with chlorine. Another analogous body is produced during the reaction. The author describes the behaviour of these bodies with certain organic principles. Zincke described the compounds benzyl-isoxylol and benzyl-paraxylol.

Neubauer showed the presence of quercetin, quercitrin, malic, oxalic, tannic, and tartaric acids, and of inosite in the leaves of the vine.

Hlasiwetz made known the results of his researches on the protein bodies, undertaken conjointly with Habermann. Rithausen discovered some years ago, among the products of the decomposition of gluten, a new nitrogenous acid, which he named glutinamic, homologous to aspartic acid. The same acid has been obtained from legumin and other matters, so that it may be considered a no less constant result of the decomposition of proteic substances than leucin and tyrosin. Previously, however, glutinamic acid had only been obtained with proteic bodies of vegetable origin. Hlasiwetz and Habermann affirm that it may be obtained from animal proteic matters, and especially from casein.

Tollens made some observations on parabanic acid obtained with uric and nitric acids.

Scheibler described new acid compounds of tungsten.

Hlasiwetz gave an account of some new derivatives of sulpho-carbonic acid, prepared conjointly with Kæchler. When bisulphide of carbon and ammonia are brought in contact with a third body, which only acts by its presence, like camphor or phenol, colourless, unstable crystals are produced, $C_2H_{10}N_4S_3$. Under the influence of feeble oxidising agents these crystals give rise to the following reaction:—

$$2(C_2H_{10}N_4S_3) + Fe_2Cl_6 = C_2H_4N_2S_4 + 2(NH_4CNS) + 2NH_4Cl + FeCl_4.$$

Rhodanammonium.

$C_2H_4N_2S_4$ forms fine crystals, insoluble in cold water, and resolved by hot water into sulphide of carbon, free sulphur, and sulphocyanide of ammonium. On mixing aniline, sulphide of carbon and ammonia crystals are obtained of the composition $C_{14}H_{18}N_4S_3$, which, if heated with water, yield ammonia, and a body answering to the formula $C_{13}H_{12}N_2S$, and crystallising in scales like benzoic acid. It is the sulpho-carbanilide of Hofmann.

Weber treated of anhydrous nitric acid and of a new hydrate of nitric acid.

Lethar Meyer described his arrangement for regulating the pressure of the air in distillation.

Schmitt gave an account of the reaction of chloride of lime on an aqueous solution of the chloride of amidophenol. In the same manner aniline is transformed into dichlorobenzol.

Grüneberg described experiments made conjointly with Hasenclever on the preparation of chlorine by Deacon's process. Hasenclever and Kemp took part in the discussion which followed.

Tollens described his researches on acrylic acid, undertaken jointly with Caspary. They obtained acrylic acid by means of bromopropionic acid, the preparation by means of allylic alcohol not giving good results. The acid boils at 140°.

Zincke inquired if Tollens had tried oxide of silver or platinum-sponge for oxidising allylic alcohol. Tollens replied in the negative.

Fittig described a new hydrocarbon extracted from coal-tar, having a boiling-point much higher than that of anthracen. It corresponds to the bibasic acid—

$$C_{12}H_8\begin{Bmatrix}COOH\\COOH\end{Bmatrix}$$

Fittig concludes that this new hydrocarbon is phenyl-naphthalin—

$$\begin{matrix}C_{10}H_9\\C_6H_3\end{matrix}\Big\}$$

The same author gave a communication on allyl-benzol, which he prepared by the action of nascent hydrogen upon cinnamic alcohol. Tollens stated that he had made analogous experiments along with Wagner.

Weddige described the preparation and properties of carbocyanic ether. It is obtained by distilling two parts of oxamithane and three parts of anhydrous phosphoric acid. It is a clear liquid, insoluble in water, on prolonged contact with which it is, however, decomposed into hydrocyanic and carbonic acids and alcohol. If the ether is treated with ammoniacal alcohol, prismatic crystals are obtained, which the author regards as carbocyanic amide, and by means of which and of chloride of carbonyl he hopes to prepare—

$$CO\begin{Bmatrix}NHCOCN\\NHCOCN\end{Bmatrix}$$

Clemens Winkler made a communication on the analysis of gases, Scheibler adding some remarks.

Kolbe described the experiments of Pfankuch on cyanoform, and those of Saytzeff on hydride of palladium.

Michaelis described experiments on supersaturation. Weber made some observations on the same subject.

Salomon gave an account of his researches on sulphocarbonic ether. This ether has, in his opinion, the constitution indicated by the formula—

$$CO\begin{Bmatrix}SC_2H_5\\SC_2H_5\end{Bmatrix}$$

and is obtained by the following reaction—

$$CO\begin{Bmatrix}OC_2H_5\\Cl\end{Bmatrix} + C_2H_5NaS = CO\begin{Bmatrix}SC_2H_5\\OC_2H_5\end{Bmatrix} + NCl$$

This body boils at 155°, whilst its isomer—

$$CS\begin{Bmatrix}OC_2H_5\\OC_2H_5\end{Bmatrix}$$

boils at 161°.

Landolt, on behalf of Schwartz, communicated a memoir on the equivalents of refraction of carbon, of hydrogen and oxygen.

Salkowski, on behalf of Gintl, communicated researches on the action of ammonia on anisic acid and its nitro-derivatives. The author has obtained a number of very interesting amido-compounds.

Hübner, on behalf of Zincke, made several communications. He entered into details on the bromo- and nitro-derivatives of toluen, obtained conjointly with Majort. Then he described experiments made alongwith Scheibler, from which it appears that anhydrous maleic acid in

presence of hydrogen forms succinic acid. He added that, according to Spezzia, the nitrate of thallium can be used for the analytical separation of chlorine and iodine.

Zincke, on behalf of Schwartz and Gintl, described the action of zinc upon a mixture of chloride of benzol and of an aromatic hydrocarbon. According to the author, the zinc acts here not chemically but by means of its presence.

Liebermann described certain beautiful blue crystals, to which he has given the name cœrulignon, and which are found in the preparation of wood-vinegar.

Carstanjen gave a summary of the researches of Schulze on the diffusion of saline solutions. He touched also upon the constitution of allylic alcohol, for which he gave the following "circular" formula:—

$$CH_2\overset{CH_2}{=}CH.HO,$$

which indicates perfectly its relations with glycerin and dichlorhydrin.

Christomenos offered some remarks on a new preparation of diphenyl and diacetyl by electrolytic action.

June 21 and 28, 1873.

These numbers contain no original chemical matter.

Bulletin de la Societe Chimique de Paris, tome xix., No. 12, June 20, 1873.

At the meeting of the Society, held May 16, M. Willm exhibited the new bulb apparatus constructed by M. Alvergniat. Three small bulbs, interposed between two large ones, are connected together by S-tubes, so that any gas which it is wished to absorb is compelled to traverse a larger portion of the absorbing liquid than in any other arrangement.

M. Tommasi described certain acid derivatives of naphthylamin, naphthyl-acetamide, and naphthylchloracetamide, obtained by the action of chloride of acetyl and chlorated chloride of acetyl upon naphthylamin.

M. Jungfleisch communicated the continuation of his researches on the action of heat upon rotatory powers.

Right camphoric acid, heated in closed vessels with water to the temperature of 150° to 350°, is transformed into two other acids, optically inactive, bearing to it the same relation which inactive tartaric acid and para-tartaric acid do to right or left tartaric acid. These two modifications are reciprocally convertible when heated along with water.

Heat Liberated by the Mutual Reaction of Alkalies and Water.—M. Berthelot.—The author has studied the action of water upon the hydrates of potassa and soda, upon ammonia, upon lime, baryta, and strontia, both hydrated and anhydrous, in order to obtain a thermic measurement of these reactions.

Function of Atmospheric Nitrogen in Vegetation.—P. P. Dehérain.—This important paper will appear *in extenso*.

Observations on a Work by M. Gaudin, entitled, "Architecture of the World of Atoms" (Architecture du Monde des Atomes).—M. West.—The researches of M. Gaudin promise to throw valuable light upon crystallography.

Researches on the Mineral Oils of Buxière-la-Grue and of Cordesn.—Jules Jaffre.—An investigation undertaken to ascertain the difference between the mineral oils obtained from bituminous schists and the petroleums of America. The author explains the absence of benzol and of naphthalin in these oils by the fact that the distiller purposely works at temperatures too low to permit of their formation.

A New Method of Assaying Plumbiferous Minerals.—Ant. Mascazzini.—(See vol. xxvii., p. 79.)

Determination of Iodine in Presence of Chlorine and Bromine.—H. Hübner.—The method is based upon the nearly perfect insolubility of thallous iodide in water, and in solutions of nitre, whilst the corresponding chloride and bromide are moderately soluble. The iodine, bromine, and chlorine should be present in the state of alkaline salts, and the solution should be dilute and neutral. A solution of thallous nitrate is added drop by drop until the precipitate formed is perfectly white. The liquid is then mixed with a little water to re-dissolve the white precipitate, and the whole is allowed to stand for 8 to 12 hours. The yellow precipitate of thallous iodide is then collected upon a counterpoised filter, washed with the smallest possible quantity of water, dried, and weighed. The washing-water contains the whole of the chlorine, which is determined as chloride of silver. The determination of iodine in presence of bromine is effected in the same manner. In both cases it is needful to avoid the use of too great an excess of thallous nitrate, and the addition of too large a quantity of water. The different solubility of the iodide and bromide of lead may also be used to determine iodine in presence of bromine by means of nitrate of lead. This method is less trustworthy than the first mentioned, and cannot be employed for the separation of chlorine and iodine.

Falsifications of Albumen.—A. Herburger.—Albumen is often adulterated with gum, dextrin, and starch. To detect these admixtures, 30 grms. of the sample are dissolved in lukewarm water. After some time the mass is stirred. If the liquid contains many white clots, the quality is inferior; that is, a notable quantity of the albumen has been coagulated by the employment of too high a temperature during desiccation. The solution is mixed with acetic acid, and then some alcohol is added to the decanted acid liquid. If gum is present, a precipitate is formed. If starch has been added, it may be recognised in the usual manner by means of iodine. If the albumen contains sugar, it is easily recognised by the use of Fehling's test.

Quantitative Examination of Iron Mordants.—H. Vohl.—If the mordant in question contains chlorine, it is precipitated by means of sulphate of silver, and the chloride of silver obtained is weighed. To determine nitrous and nitric acids, the filtrate is precipitated with baryta. The sulphuric acid and the oxides of iron are precipitated, whilst the filtrate, after prolonged digestion in heat, contains the nitric and nitrous acids in the state of barytic salts. The precipitate is well washed in boiling water, and the excess of baryta is removed by means of a current of carbonic acid gas. The whole filtrate, with the washings, is brought to a definite volume, say 100 c.c. The presence or absence of nitrous acid is ascertained by means of well-known tests. Then the amount of baryta contained in 5 or 10 c.c. of the liquid is determined, either volumetrically or gravimetrically. If no nitrous acid is present, the whole of the baryta present in solution corresponds to the nitric acid, which is thus determined indirectly. If both nitrite and nitrate are present, a known volume is evaporated to dryness, and the residue is taken up in absolute alcohol, which dissolves the nitrite only, leaving the nitrate untouched. The determination of the baryta in each of these salts gives the respective amounts of nitrous and nitric acids. To determine the ferrous oxide in the mordant, it is diluted with water, and digested in the cold with carbonate of lime in a flask filled with carbonic acid. When the liquid has grown clear, it is filtered in a current of carbonic acid and washed in distilled water. The solution containing the ferrous salt is then oxidised with chlorate of potassa and hydrochloric acid, and the ferric oxide thus obtained is precipitated with ammonia. The presence in a mordant of a ferrous salt and of nitrous and nitric acids is in general injurious. (Few, if any, practical men in England will agree with the assertion conveyed in the last sentence. The quality of an iron mordant may be ascertained much more perfectly by dyeing a swatch of calico with it, and with an extract of logwood, than by the operation recommended above).

Dyeing Aniline Blacks on Cotton Yarn.—MM. de Vinant.—This process requires great care to prevent the blacks from being clouded:—(1). The cotton-yarn, well boiled out, receives seven turns in a bath composed of 200 grms. of sulphate of copper for every kilo. of material, dissolved in water slightly acidulated with hydrochloric acid. It is then well wrung out. (2). It receives five turns in a bath at 50°, containing 50 grms. hydrosulphate of soda per litre, and is rinsed. (3). It receives seven turns in a bath of 10 litres of water, 180 grms. chlorate of potash, and 170 grms. sal-ammoniac, dissolved in heat, and then mixed with 480 grms. chloride of aniline. (4). It is stretched out very regularly in a hot drying room at 24° for forty-eight hours. (5). Lastly, it receives four turns at 30°, in a bath containing 1 grm. bichromate of potash per litre, and is well rinsed and dried. If the blacks are reddish, they may be passed through a bath containing 1 litre bleaching liquor at 6° to 100 litres of cold water.

Pearl Grey with Aniline Violets.—Aniline violets applied in very feeble tints furnish pearl greys, whose tone varies with that of the violet employed, and is pure in proportion to the excellence of the dye. As the quantity of colour employed is very small, only the highest class of aniline-violets should be employed. Cotton may be dyed without mordant. The bath should contain a little soap, without acid, though a very small quantity of tartaric or acetic acid is added at the end. For pure wool the colour is dissolved in luke-warm water alone, without acid.

Printing Ink for Use in Calico Printing.—The following mixture gives fine results:—

	Parts.
Venice turpentine	9
Soft potash soap	10
Oleine	4
Lamp-black	6
Bleu de Paris	1
Oxalic acid	0·5
Water	1

The turpentine is first heated along with oleine; then the soap is placed on a levigating slab, and the mixture of turpentine and oleine is very gradually incorporated with it. When this process is complete the lamp-black is worked in, having been first ground and sifted. Finally, with constant grinding, the Paris blue is added, and the oxalic acid and water, which are previously mixed and slightly warmed. The Paris blue and oxalic acid may be replaced with carmine of indigo.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Mène, No. 23, April 11, 1873.

Soaps and Perfumery with an Aluminous Base.—M. Bonnamy.—M. Bonnamy, struck with the inconveniences resulting from the use of toilet-soaps with a base of potash or soda, has prepared alumina soaps. These are, as a matter of course, neutral and free from causticity, and being insoluble in water their detergent action is simply mechanical, not chemical.

Indelible Ink-Powders.—E. Rey.—This paper praises the inks in question, but throws no light upon their composition.

No. 24, April 18.

This number does not contain a single chemical article.

Moniteur Scientifique, du Dr. Quesneville, June, 1873.

The Function of Septic Agents in the Animal Economy, and the Nature of Septicæmia.—Ferrand Papillon, abstracted from the recently-published results of Davaine.—A very important physiological paper. We note the striking fact that, according to the experiments performed, the septic power of putrescent blood stands in no relation with its offensive odour, the latter continuing to increase while the poisonous properties are diminishing.

The Poles in Magnetisation.—E. Duchemin.—A purely physical paper.

A Patronised Ink.—E. Duchemin.—A controversial paper on a so-called "indestructible ink," which Boussingault had pronounced indelible, and which the author has succeeded in effacing by means of alcohol and benzol.

Experiments on the Effects of Dynamite.—MM. Roux and Sarran.—Dynamite ignited by violent percussion—*e.g.*, by the detonation of a strong fulminating capsule—explodes even in the open air, and produces an effect, if confined, equal to that of ten times its weight of gunpowder. If ignited in any other manner, it burns quietly if in the open air, and if confined it explodes. But this explosion, whatever may be the temperature and the pressure, is of a different nature. Instead of a detonation, or explosion of the first order, it is merely an explosion of the second order, equal in effect to that produced by double the weight of gunpowder. The experiments on which this conclusion is founded were made with "No. 2 dynamite" of Vouges, containing 50 per cent of nitro-glycerine, and exploded with a Gevelot detonator, containing 0·25 grm. of fulminate. But even with dynamite at 90 per cent the results were found to be quite similar.

Production of Potash Salts at Stassfurt.—Theodore Becker.—A few details on these mines, which have produced so great a revolution in the manufacture of potash salts, will be useful. Stassfurt is situate about 20 kilos. from Magdeburg, on the Anhalt frontier. The geological formation on which it lies is the variegated sandstone. The presence of a bed of rock-salt below this stratum was suspected in 1838. Borings were executed by order of the Prussian Government, and in 1851 the presence of a deposit of rock-salt, at least 330 metres in thickness, was ascertained. The formal working of the mines began in 1857. Before reaching the salt it was necessary to sink 260 metres through the sandstone, the gypsum, and the marl. The saline deposit does not consist exclusively of common salt, and may be divided into four chief regions. The lowest bed is the largest, and consists entirely of rock-salt traversed by slender veins of karstenite. It is about 240 metres in thickness. We find next the region of *polyhalite*, still composed of rock-salt, but intersected by veins of 2 to 3 c.m. thick, formed of polyhalite, a mineral composed of sulphates of lime, magnesia, and potassa, agreeing with the formula—

$$2(CaO,SO_3)+MgO,SO_3+KO,SO_3+2HO.$$

This layer is about 64 metres in thickness, and is composed on an average of 91·2 per cent chloride of sodium, 0·66 of karstenite, 6·63 of polyhalite, and 1·51 of hydrated chloride of magnesium. To this stratum succeeds another, of a different composition, and characterised by the presence of a saline mineral named *kieserite*. It consists of mono-hydrated sulphate of magnesia, in small microscopic needles. The layer contains 65 per cent chloride of sodium, 17 of kieserite, 13 of carnallite (see below), 3 chloride of magnesium, and 2 of karstenite. Its thickness is 56 metres. The upper region is formed of a group of salts chiefly magnesic and potassic, and formerly called *riddance salts*, because they were at first without industrial application, and were merely extracted to reach the rock-salt below. These salts are now the foundation of the trade of Stassfurt. The principal salt is *carnallite*, a chloride of potassium and magnesium,—

$$KCl+2MgCl+12HO.$$

It has a red colour, due to the presence of oxide of iron in microscopic lamellæ. There are found also, in this deposit, *Sylvine* or *Howellite*, a chloride of potassium containing often small quantities of sulphate of potassa, and of sulphate and chloride of magnesium; *Tachyhydrite*, a carnallite in which the chloride of potassium is replaced by chloride of calcium; and *Boracite*, a combination of the borate and chloride of magnesium,—

$$(6MgO8BO_3+MgCl).$$

Stassfurt, as we have stated, lies on the Prussian frontier, towards the borders of the duchy of Anhalt. The Prussian workings, therefore, could not be extended to the south-west, where the geological conditions were most favourable. In 1855 the Government of Anhalt commenced operations within its own territory, with perfect success. The saline beds were reached at the depth of 145 metres, and soon a new salt was discovered in great quantity, giving a new impulse to the trade of the district. This is *Kainite*, a compound of sulphate of magnesia and chloride of magnesium. Its discovery enabled the inhabitants to enter upon the manufacture of pure sulphate of potash, which is largely exported to England and the United States. In M. Becker's memoir the reader will find an account of the purification of the crude salts as obtained from the mines. Their applications are numerous. The chloride of potassium is used in the manufacture of saltpetre and carbonate of potassa; the sulphate of potassa is in great demand in the glass and alum-works. Stassfurt exports, also, sulphate of magnesia, chloride of magnesium,—which is extensively used in England for the discreditable purpose of adding to the weight of textile goods, and rendering them hygroscopic,—bromine to an extent almost sufficient for the consumption of Europe, and boracic acid. Lastly, the impure salts obtained as waste in the various refining processes—consisting principally of salts of soda, magnesia, and potassa—are skilfully combined, and sold as mineral manures, more or less rich in potassa and magnesia. The demand for these manures has greatly increased of late years, especially in England and Germany. In 1869 the Prussian mine alone yielded 109,075,000 kilos. of salts of potassa, and 56,332,000 kilos. of rock-salt, representing a total value of 916,960 francs. (It is interesting to note that whereas the application of potassic salts in agriculture, some fifteen or twenty years ago, was found to produce little or no benefit, they are shown by more recent experiments to be highly valuable. This change is what they would lead us to expect. Liebig has shown that the use of manures which contain only *some* of the ash-constituents of the crops only enables the soil to be more rapidly exhausted of the other necessary constituents. We have been for years employing manures containing phosphoric acid, lime, and nitrogen, and our soils are beginning to crave a supply of potash). M. T. Becker's important memoir, on the separation and refining of the various salts and other products above mentioned, will be given at length on a future occasion.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxi., No. 9, June 26, 1873.

Determination of the Alcoholic Strength of Liquors.—If an alcoholic or acetic solution is allowed to flow from a small orifice, the drops are the larger and heavier the more concentrated is the solution. Hence, if we count the number of drops necessary to make up a certain volume, we may, by means of a special table, determine the strength of wine, beer, or vinegar.

New Material for Paper-making.—Messrs. Jourdeuil, Parisot, and Co., of Beire-le-Chatel (Cote d'Or), have patented the stem of the hop as a material for the manufacture of paper.

No. 10, July 3, 1873.

Portable Liquid Gas.—M. Roche, of Paris, has contrived a lamp for burning the light mineral oils without danger or nuisance. He asserts that his lamp consumes, per hour, 50 grms. of light oil, giving a light equal to that obtained from the combustion of 200 cubic metres of coal-gas, the cost ranging according to the price of the oil in different localities, from 1 to 5 centimes.

Zinc-Green.—Elsmer manufactures zinc-greens by mixing 5 parts oxide of zinc, 1 part sulphate of cobalt, and water enough to form a paste. This mass is thoroughly incorporated and heated to redness, when it yields a fine powder, of a deep green. If the amount of oxide of zinc is increased to 10 parts a grass-green is obtained, and with 20 parts a still lighter. The last proportion serves as a substitute for the dangerous poison known as Schweinfurt-green.

Reimann's Färber Zeitung, No. 25, 1873.

This number contains receipts for dyeing apple-green on wool, cochineal-red on cotton yarn, for which the reader is referred to an advertisement, and Vert Horizon on silk.

Solution of India-rubber for the Manufacture of Elastic Tissues.—The raw india-rubber is soaked in clear water, and boiled for about an hour to remove dirt. It is then taken out of the water, and cut into round slices about 1 centim. in thickness. It is then rolled out into layers about 2 metres long and 0·15 metre broad. The rubber is then dried in a warm chamber. After the drying follows the solution. About 26 kilos. of rolled caoutchouc are placed in a wooden vat lined with zinc, and treated with a mixture of 50 kilos. benzol and 70 kilos. oil of turpentine. Both these liquids must be perfectly free from fatty matters, or the solution of india-rubber will be useless. The caoutchouc, before being brought in contact with the solvents, is torn up into small fragments. The mass is stirred occasionally till it forms a thick, homogeneous liquid. To test the benzol and turpentine, small portions of each are evaporated to dryness in the water-bath. If any trace of fat remains the sample is at once rejected.

The Editor gives also receipts for a Russian green on wool, for yellowish brown, red-brown, and alkali-blue on cotton; and for printing rainbow styles in rose, blue, and orange.

Products of Resin.—Schrœder, during an investigation of the oxidation-products of rosin (colophonium), discovered an amorphous resinous acid, isophthalic and trimellitic acid—a derivative of the acid occurring in mellite.

New Washing Agent.—A contemporary journal, devoted to the art of dyeing, informs us that *paraffin* is now used instead of benzol or turpentine for cleansing textile fabrics!

Utilisation of Old Dye-Liquors.—As a means of extracting from such liquors everything of value, it is proposed that the bath in which scarlet has been dyed should be gradually exhausted by dyeing with it successively lighter and lighter shades. A better proposal is, where practicable, to keep one and the same bath for the same colour. (Many experienced scarlet-dyers maintain that an old flot gives the best results.

Dressing for Silks.—A solution of gum tragacanth is recommended. Silks got up in this manner do not show rain-spots.

NOTES AND QUERIES.

Lemon-Yellow.—I shall take it as a great favour if you or any of your correspondents will kindly inform me how to make a bright lemon-yellow from chromate of potash and nitrate of lead—a yellow that will keep its colour on exposure to the air and after being well washed; I have tried many experiments, but they all change to a deeper colour. If you can give me any hints about the same, I shall feel greatly obliged.—L. C.

TO CORRESPONDENTS.

Miss B.—Your enquiries should be addressed to a medical paper.

Volta.—Prussian blue, dark ultramarine, or finely-ground indigo may be used; but there are no pigments *soluble* in linseed oil.

J. F. Armstrong, H. W., and others.—Messrs. Trübner and Co., 60 Ludgate Hill, would procure it for you.

THE CHEMICAL NEWS.

VOL. XXVIII. No. 712.

ON THE

PHRASEOLOGY EMPLOYED IN TEACHING FUNDAMENTAL FACTS IN CHEMISTRY.

By C. R. A. WRIGHT, D.Sc. (Lond.),
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(1). THE phraseology ordinarily in use in the description of fundamental chemical phenomena is open to the objection that either it is diffuse and wanting in terseness and precision, or else words are employed which go beyond the requirements of the moment, inasmuch as they connote not merely the facts themselves but also hypotheses, the full discussion of which is impossible at the commencement of a course of instruction; in consequence, a tendency to one-sidedness in looking at questions concerning theory and speculation is often unintentionally developed. The student, being taught to take certain matters of this kind for granted during the early part of his course of study, is frequently unable to divest himself wholly of preconceived notions on the subject at a later period in his course of study, when he comes to examine the bearings and scope of these hypotheses. To render the fallacy of *petitio principii* less imminent, the mode of teaching certain fundamental doctrines briefly described below is suggested, the method having been tested by some years' trial and found to meet the requirements of the case, viz., enabling the facts themselves to be stated in terse language, without involving in any way any assumptions or hypotheses whatever beyond certain universally admitted conventions.

(2). Quantitative analysis shows (Dalton) that any pair of so-called elements capable of being obtained from a given homogeneous compound* (and hence stated in ordinary language to exist in, or be components of, that compound) are present in that compound in proportions by weight, related by a simple numerical law to those in which the same pair of elements exist in any other homogeneous compound; this law of multiple proportions being that if the relative quantities by weight in which any two elements co-exist in a given compound be represented by a and b, the relative quantities in which they co-exist in any other compound are indicated by a and $\frac{m}{n}b$, where m and n are integers rarely of high values.

Like all experimental generalisations, this statement only expresses the result of any given experiment within a certain degree of approximation; but it is uniformly found that the more care be taken in the quantitative determinations of the substances present, the more accurate the processes employed, and the greater the purity of the body operated on, the more nearly is the result of each experiment expressed by the generalisation.

(3). It hence follows that the composition by weight of all homogeneous compounds is indicated by the general formula, $x_1c_1+x_2c_2+x_3c_3+ \ldots \ldots +x_nc_n$, where—

$$c_1, c_2, c_3, \ldots c_n$$

are certain numbers applied respectively to each of the n known elements, and $x_1, x_2, \ldots x_n$ coefficients, the values of which are 0 in the cases of such elements as are not present in any given compound under consideration, and are simple integers in the cases of such elements as are present in that compound. The value of the c's thus obtained from quantitative analysis, and so chosen that the values of the x's in the general formula shall be as low as possible in most cases, constitute what are spoken of as the *combining numbers* of the elements. Thus, 1, 6, and 8 being the combining numbers of hydrogen, carbon, and oxygen respectively, many compounds of these elements have compositions expressed by the formula $m\times 1$ (of hydrogen) $+n\times 6$ (of carbon) $+p\times 8$ (of oxygen), where m, n, and p have very simple values. Thus—

Water	$m=1$	$n=0$	$p=1$
Carbonic acid ..	$m=0$	$n=1$	$p=2$
Carbonic oxide ..	$m=0$	$n=1$	$p=1$
Marsh-gas	$m=2$	$n=1$	$p=0$
Acetic acid	$m=1$	$n=1$	$p=1$
	&c.,	&c.	

From these considerations, then, are derived what are spoken of as the "Old series of combining numbers" (Dalton, Berzelius, &c.).

(4). Manifestly any one of this series of numbers might be multiplied or divided by a simple integer without invalidating the applicability of the general formula. Thus, if $2c_n$ were taken as the combining number instead of c_n, a compound indicated by the formula—

$$x_1c_1+x_2c_2+ \ldots \ldots +x_nc_n$$

on the old scale would be indicated by—

$$2x_1c_1+2x_2c_2+ \ldots +x_n(2c_n):$$

or if $\frac{c_n}{2}$ were taken instead of c_n, the same compound would be indicated by—$x_1c_1+x_2c_2+ \ldots +2x_n\left(\frac{c_n}{2}\right)$

For convenience, a "new series of combining numbers" is constructed (Gerhardt, Canizzaro, &c.), where the combining numbers are in some cases identical with the old ones, in others are multiples of them, the precise value of each number being fixed by reference, not merely to gravimetric composition, but also to volumetric composition and the specific gravity of the substances concerned in the vaporous state (Criterion I.). When this criterion is inapplicable, a convention based upon specific heat is taken (Criterion II.); and where both of these criteria are inapplicable, chemical analogy is taken as Criterion III.

(5). *Criterion* I.—Experiment shows (Gay-Lussac) that a given bulk of any compound vapour contains a volume of any volatile component element (examined under the same circumstances of temperature and pressure) which is an integral multiple of a simple fraction of the bulk of the compound vapour; *i.e.*, one volume of compound vapour contains $\frac{m}{n}$ volumes of each vaporous constituent element, m and n being integers rarely of high values, and varying in value with each constituent and with the nature of the compound.

(6). As a subsidiary unit of volume (the absolute unit being 1 cubic metre) is chosen the (variable) bulk occupied by 1 grm. of hydrogen under the conditions that obtain during any given experiment under consideration. This unit, which may be conveniently designated as a *metropneum* (*μετρον* and *πνευμα*) has, at a pressure p and a temperature t, approximately the value—

$$0{\cdot}0112\times\frac{273+t}{273}\times\frac{760}{p}$$

absolute units of volume. Hence one metropneum of compound vapour contains $\frac{n}{m}$ metropneums of any given gaseous elementary constituent, m and n being integers.

(7). The vapour density of any given constituent being s in reference to hydrogen, $\frac{n}{m}$ metropneums of that constituent must weigh $\frac{n}{m}\times s$ grms.; *i.e.*, one metropneum of compound vapour contains $\frac{ns}{m}$ grms. of any given vapor-

* Solutions and other apparent exceptions to this rule are generally viewed as not being homogeneous compounds, but as being simply indeterminate mixtures of two or more dissimilar substances.

ous elementary constituent, Taking into consideration all the volatile compounds of this element (*i.e.*, all the different values which the expression $\frac{ns}{m}$ can have, m and s being constant), there must be a greatest common measure of all these values; the numerical value of which G. C. M. must be $\frac{s}{m}$, when n has in each case the minimum integral value possible.

Thus the following values of the G. C. M.'s are obtained:—

Hydrogen	0·5	Mercury	100·0
Nitrogen	7·0	Arsenic	37·5
Oxygen	8·0	Phosphorus ..	15·5
Sulphur	16·0	Bromine	40·0
Chlorine	17·75	&c.,	&c.

The values of m in the expression $\frac{s}{m}$ (when this expression is the G. C. M.) being found to be—

1. In the case of mercury (probably zinc, cadmium, &c.).
2. In the case of hydrogen, oxygen, chlorine, bromine, iodine, probably potassium (Dewar and Dittmar), nitrogen, sulphur (at high temperatures), &c., &c.
4. In the cases of arsenic and phosphorus.
6. In the case of sulphur (at comparatively low temperatures).

(8). Hydrogen being conveniently made a standard of reference, its combining number is taken as unity; hence, all the other numbers require to be doubled: whence the following equation—$C_n = 2g_n$, when C_n is the combining number (new series) applied to any given element, and g_n the G. C. M. for that element obtained as above from the vapour density of the element, s, and the experimental determination of the minimum value of m.

(9). Many elements not themselves volatile at measurable temperature yield volatile compounds with other elements; *e.g.*, carbon, boron, silicon, iron, &c. When several volatile compounds of a given element are compared, it is uniformly found that the numerical values of the weights of that element contained in a metropneum of each compound vapour respectively have a G. C. M., just as the numerical values of the weights of any volatile elements contained in a metropneum of all its compounds respectively have a G. C. M., viz., $\frac{s}{m}$.

Twice the value of this G. C. M. is similarly taken as the combining numbers of the element in question (new series).

(10). The experimental errors involved in vapour density determinations are frequently of such magnitude that the results of any one given experiment only approximate to those which would be in exact conformity with the generalisations of the existence of a G. C. M. of the weights or volumes of a given element contained in a metropneum of the vapours of each of its compounds; still, the more care is taken in avoiding sources of error, the closer is the approximation.

Where a combining number is fixed by the determination of a G. C. M., it is evident that the existence of only one or two volatile compounds renders the determination impossible or unsatisfactory; *i.e.*, the combining number thus deduced is not always identical with that fixed by Criterion II. or III. (*infra*). Thus, from the vapour density of ferric chloride, 112 would be taken as the combining number of iron; but both the specific heat of metallic iron and analogy with aluminium (the combining number of which, deduced from the chloride, is double of that deduced from the methide and ethide, Buckton and Odling), indicate 56 as the combining number.

Compounds that decompose on heating, or "dissociate," are of course excluded in the determination of a G. C. M., there being no longer one homogeneous body to deal with in such cases.

(11). *Criterion* II.—In the case of all elements that are solid at measurable temperatures, and the melting-points of which do not greatly exceed the melting-point of platinum (*i.e.*, in the case of all elements that give volatile compounds, save those gaseous at the common temperature, carbon, silicon, and boron), it is found that the apparent specific heat of the solid element between $t°$ and $t°+1$ (where $t°$ lies between -50 and $+100$) closely approximates to $\frac{6·5}{c}$, where c is the combining number (new scale); or $c = \frac{6·5}{h}$, where h is the apparent specific heat.

In the case of elements where Criterion I. is not applicable, it is found that a very simple multiple of the combining number (old scale) (§ 3) also closely approximates to $\frac{6·5}{h}$; this multiple of the old combining number is then taken as the combining number (new scale).

Thus the combining number of iron (old scale), deduced from gravimetric analysis only, is found to be 28; the apparent specific heat, however, closely approximates to $\frac{6·5}{2\times 28}$; wherefore, 2×28, or 56, is taken as the combining number (new scale). Similarly, 113·4 is taken as the combining number of indium (Bunsen), instead of $37·8 = \frac{113·4}{3}$, as deduced from gravimetric analysis only.

(12). *Criterion* III.—The particular cases of the general expression, $x_1c_1+x_2c_2+x_3c_3+ \ldots + x_nc_n$, produced by varying the values of the x's, may be briefly denoted by applying to each element actually present in a given compound a symbol indicating its name and combining number, and repeating each symbol as many times as is denoted by the value of the x attached to that symbol in the particular case examined. Thus, a collection of symbols, termed a *formula*, is obtained; when the x's have the minimum possible values, the formula is termed an *empirical formula*. Thus, water is indicated by the empirical formula HHO; butyric acid by CCHHHHO. This notation is conveniently abbreviated by writing a suffix, x, instead of repeating the symbol x times; thus—Water, H_2O; butyric acid, C_2H_4O.

(13). Formulæ, however, may be made to indicate not only the ratio by weight and volume in which the components are present, but also their vapour densities. From the circumstance (§ 8) that *double* the G. C. M. for any given element is taken as the combining number of that element, it follows that the empirical formula of a compound must indicate either the weight of *two* metropneums of that compound, or a sub-multiple thereof; and hence, by multiplying the empirical formula by some suitable integer, a formula (termed the *rational formula* of the compound) is obtained, which denotes not merely the gravimetric and volumetric composition of the compound, but also the absolute weight in grammes of two metropneums of its vapour. Thus, the rational formula of water is identical with the empirical formula H_2O; the rational formula of butyric acid is double its empirical formula, being $C_4H_8O_2$.

(14). Elements which do not yield volatile compounds, and the apparent specific heats of which are unknown, have combining numbers which are fixed by this convention; such multiples of the numbers deduced from gravimetric analysis (§ 3) are taken as will enable compounds of these elements to be indicated by formulæ which resemble in suffix values the rational formulæ of compounds of other elements to which the first-named compounds are chemically analogous.

Thus (apart from evidence derived from Criteria I. and II.), the rational formula of aluminic chloride is Al_2Cl_6; ferric chloride is chemically analogous to aluminic chloride, and can be indicated by a similar formula, Fe_2Cl_6, if the value denoted by Fe (combining number, new scale) be made = 56.

(15). The symbols involved in chemical formulæ, though

unlike algebraic ones in this respect, that juxtaposition does not mean multiplication (the sign + being understood between each pair of adjacent symbols), are yet like them in one property, viz., that of commutation; by adopting fixed conventions as to the mode in which the symbols in a rational formula are arranged among themselves, many facts in the chemical history of a compound may be indicated. Thus, the rational formula of acetic acid being $C_2H_4O_2$, or CCHHHHOO, a great many facts and chemical changes in which acetic acid is concerned may be at least partially indicated and called to mind by arranging these eight symbols thus—CHHHCOOH, or $CH_3.CO.OH$. Formulæ whose constituent symbols have been thus arranged, so as to connote points in the chemical history of the compound indicated, are referred to as *dissected formulæ* (structural formulæ).

(16). From the above definition of a rational formula, it is evident that every such formula indicates the same bulk, viz., two metropneums; the concrete weight in grammes of this bulk of compound is conveniently referred to as a *metrogramme* (or *metrogram*). Thus, the metrogram of water is 18; *i.e.*, 2 metropneums of steam weigh 18 grammes.

(17). In the case of elements, rational formulæ are applied, based on the same principles as those in use for compounds. Since $2\frac{s}{m}$ is by definition the combining number (§ 8), and, as $2s$ indicates the weight of 2 metropneums, m must indicate the number of times the symbol is repeated in the rational formula of the element; thus—

Element.	Rational Formula.	
Mercury	Hg	
Hydrogen	HH	or H_2
Chlorine	ClCl	or Cl_2
Oxygen	OO	or O_2
Ozone	OOO	or O_3
Phosphorus	PPPP	or P_4
Sulphur (at low temperatures)	SSSSSS	or S_6
,, (at high temperatures)	SS	or S_2

It may be noticed, *en passant*, that allotropic modifications are often indicated by different rational formulæ; *e.g.*, oxygen and ozone, or the two allotropic sulphur vapours.

(18). The rational formulæ of non-volatile elements and compounds are necessarily indeterminate; in this case the convention is adopted that the empirical formulæ are regarded as the rational ones (unless reasons based on analogy or chemical properties lead to higher formulæ). The empirical formula of an element necessarily consists of a single symbol; thus silver is considered to be indicated by the rational formula Ag; analogy with hydrogen and potassium, however, would lead to the rational formula Ag_2.

Chloride of sodium similarly is assumed to have the rational formula NaCl, although it is not at all improbable that a higher formula may hereafter turn out to be the rational formula.

In most cases analogy and other circumstances are in favour of the identity of the empirical and rational formulæ, but not always. Thus (apart from vapour density) the empirical formula of ferric chloride is $FeCl_3$; analogy with aluminic chloride would double this formula, and the determination of the actual vapour density of ferric chloride also gives the rational formula Fe_2Cl_6.

(19). The term *a proportion* may be conveniently used to indicate not a fixed concrete amount like the metrogram, but a *relative weight*—which is taken in the ratio of the metrogram in the case of compounds, in the ratio of the combining number in the case of elements. Thus—

1 proportion of hydrogen = 1 part by weight.
,, ,, oxygen = 16 parts ,,
,, ,, water = 18 ,, ,,

(20). By the use of the terms *combining number* (new scale), *metropneum*, *metrogram*, and *proportion* as above defined, the fundamental facts connected with the gravimetric and volumetric composition of substances, and their vapour densities, can be expressed in terse language which involves no hypothetical assumption whatever. Thus the essential facts connected with water are—

1. Oxygen, hydrogen, and no other elements are present in water.
2. These elements are present in the respective weights 8 and 1.
3. These elements are present in the respective volumes 1 and 2.
4. The vapour densities of steam and oxygen are respectively 9 and 16 in reference to hydrogen.

Then the phrase "one proportion of water contains one proportion of oxygen and two of hydrogen," or "one metrogram of water contains half a metrogram of oxygen and one metrogram of hydrogen," indicates all these facts, it being remembered that the rational formulæ of oxygen and hydrogen are O_2 and H_2 respectively.

All the advantages of succinctness and terseness possessed by such phrases as the following—"the molecule of water contains two atoms of hydrogen and one of oxygen, the molecule of oxygen containing two atoms of oxygen, and that of hydrogen two atoms of hydrogen"—are thus gained without the use of language necessarily involving hypotheses or assumptions; and hence, by employing the terms above defined, the mind of the student may be left wholly free to appreciate the just value of such hypotheses when his knowledge of facts is sufficiently extensive to enable him to understand their bearings.

ON A COMBINATION OF UREA WITH CHLORACETYL.*

By M. D. TOMMASI.

THIS compound, which results from the substitution of an atom of monochloracetyl, C_2H_2ClO, for an atom of hydrogen in urea, and which I shall designate by the term chloracetyl-urea—

$$\left.\begin{matrix} CO'' \\ (C_2H_2ClO)'H \\ H_2 \end{matrix}\right\} N_2,$$

is produced by the direct combination of urea with chlorated chloracetyl.

In order to prepare this compound, there is introduced into a long-necked flask, well dried, a molecule of urea previously desiccated at 100°, and a molecule of pure chloride of chloracetyl. The mixture of the two bodies is effected without disengagement of heat; but soon there is established a brisk reaction, the mass becomes liquid, strongly heated, and commences ebullition; quantities of hydrochloric acid are disengaged, and at the same time a white solid mass attaches itself to the sides of the flask. This reaction should be left to itself, and when it is terminated the flask should be heated for some hours on a water-bath until the reaction is completed, which is expressed by the following formulæ:—

$$\left.\begin{matrix} CO'' \\ H_2 \\ H_2 \end{matrix}\right\} N_2 + \left\{\begin{matrix} (C_2H_2ClO)' \\ Cl \end{matrix}\right\} = \left\{\begin{matrix} H \\ Cl \end{matrix}\right\} + \left\{\begin{matrix} CO'' \\ (C_2H_2ClO)'H \\ H_2 \end{matrix}\right\} N.$$

The white product which covers the sides of the flask is washed several times with cold distilled water, pressed between folds of paper, and dissolved in boiling alcohol; the alcoholic solution is to be filtered, and allowed to remain during twenty-four hours. At the end of this time the capsule will be covered with beautiful light yellow-coloured crystals, which may be purified by several crystallisations in alcohol with some animal black.

Chloracetyl-urea crystallises in fine colourless needles

* Communicated by the Author.

insoluble in cold water, slightly soluble in boiling water. Alcohol at 40° density dissolves it feebly in the cold, and in rather greater quantity with heat. Heated on an oil-bath in a test-tube, it commences to decompose at a temperature of 160°; at the same time a small portion of the unaltered product is sublimed and deposited on the cold sides of the tube in fine white and silken needles. Heated on a plate of platinum, chloracetyl-urea melts and disengages white vapours. Fuming nitric acid attacks it at the ordinary temperature, with disengement of gaseous products, amongst which I have ascertained the presence of carbonic acid. Concentrated nitric acid very slightly dissolves it in the cold, in greater quantity with heat without decomposition. The behaviour is the same with sulphuric, hydrochloric, and acetic acids. Chloracetyl-urea is not precipitated by mercurous nitrate, nor by nitrate of silver. When we cause nascent hydrogen to react on chloracetyl-urea, in the place of obtaining acetyl-urea and hydrochloric acid, as the following equation would indicate:—

$$\left.\begin{matrix}CO''\\(C_2H_2ClO)'H\\H_2\end{matrix}\right\}N_2+\left\{\begin{matrix}H\\H\end{matrix}\right\}=\left\{\begin{matrix}H\\Cl\end{matrix}\right\}+\left.\begin{matrix}CO''\\(C_2H_3O)'H\\H_2\end{matrix}\right\}N_2,$$

we obtain a crystallisable compound very soluble in cold water. Not having at my disposal sufficient quantity of this new product, it has been impossible for me to analyse it.

The analysis of chloracetyl-urea has given the following results:—

	Calculated. ($C_2H_5ClO_2N_2$.)	Observed.	
Carbon	26·37	27·01	26·52
Hydrogen ..	3·66	3·87	3·69
Chlorine	26·00	25·99	25·46
Nitrogen	20·51	20·11	20·63
Oxygen	23·46	,,	,,

When a small quantity of chloracetyl-urea (about half a milligramme) is placed on the end of the tongue, we experience no particular sensation: but soon, at the end of two or three minutes, there occurs a burning taste in the larynx, accompanied with sharp pain and a sensible difficulty of respiration. These symptoms disappear ordinarily in an hour.

We may conclude, from experiments made on animals, that chloracetyl-urea does not belong to the class of violent poisons.

These researches have been made at Sorbonne, in the chemical laboratory of M. Schützenberger.

INDIUM IN AMERICAN BLENDES.

By H. B. CORNWALL, E.M.

In a specimen of zinc blende from W. Ossipee, New Hampshire, handed me by Mr. Lewis, of the firm of Webster and Lewis, metallurgists, I have detected by the spectroscope a notable amount of indium. The blende is resinous in appearance, with rather large cleavage surfaces, and is extensively mined for the purpose of obtaining lead and silver, as it carries a considerable proportion of somewhat argentiferous galena. It was examined by the method given by Richter in Plattner's "Manual of Blowpipe Analysis," viz., solution in nitro-hydrochloric acid, filtration, and precipitation of the oxides of iron and indium with a sufficient excess of ammonia to re-dissolve the oxide of zinc. The precipitate, collected on a filter and thoroughly dried, was then moistened with hydrochloric acid, and tested with the spectroscope, giving one distinct indium line.

A second specimen, from the cabinet of the School of Mines, labelled Eaton, N.H., also gave a fainter indium reaction, but, as it is very similar in appearance to the above blende, I think they are probably from the same vicinity. To obtain the indium spectrum from this second specimen, it was necessary to repeat the operation of moistening the oxides and bringing them into the flame two or three times, as thus the chloride of copper spectrum, due to imperfect washing of the precipitate, grew gradually less intense, and the indium line could be discerned flashing out just as the oxides were brought into the flame, and before the chloride of copper spectrum appeared.

On this second specimen I also tried precipitating the indium from the original solution with zinc, after evaporation with sulphuric acid and separation of the sulphate of lead, but the indium line could not be seen much better than by the other method, which is more rapid.

The following blendes were examined without showing indium:—From Warren, N.H.; Wurtsboro', Ellenville, and Lockport, N.Y.; Phœnixville, Friedensville, and Wheatley Mine, Pa.; Ducktown, Tenn. (the variety rahtite); Shulsburg, Wis.; and Galena, Ill.

PS. Since writing the above, I have examined blendes from Silver Hill, N.C.; Prince's Bay, Lake Superior (with native silver and calcite); Alpine Co., Col.; and Roxbury, Conn. The Roxbury blende contains so much indium that it can be detected in the raw powdered blende, without using acids.—*American Chemist.*

ON THE ENERGIES OF THE IMPONDERABLES,

WITH ESPECIAL REFERENCE TO THE

MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from p. 17).

We are indebted to "energy" for all we have, and all that men have won. For example, this building and all that it contains is an example of one of the energies of gravity. The lightning, with its thunder, is an example of the energy of electricity. Power of hearing and of speaking are examples of the energy of vitality. The bread eaten and the wine drank are assimilated and become ours by the energy of affinity. It is owing to the energy of light that vision can be had; and to the energy of heat that railways and locomotion can be utilised.

The word "energy" itself, which has in these days, Phœnix-like, risen from its ashes, and which plays so important a part in the title to this course of Cantor lectures, may properly claim some notice.

The word has been adopted, rejected, and revived. It seems to have been first used by Lucretius, a Roman philosopher, who was born B.C. 95 and died B.C. 55. The word had been forgotten or laid in oblivion until Dr. Young, in his lectures at the Royal Institution in 1807,† explained what he meant by energy, and illustrated his meaning by the impact of an ivory ball or balls upon a line of suspended balls.

Here are several ivory balls suspended so as to touch each other. If the end one be raised a little, and then allowed to fall, the ball at the other end will be driven away. The motion in the last ball resulted from energy expended in the raising of the first ball, and this first ball was raised by the energy of vitality. When, however, vitality no longer puts forth energy, then the energy of gravity operates, and causes the ball to fall. Such a simple experiment revived the word "energy," which has thus been re-introduced, and bids fair to hold an important place in science annals for some years.

* The Cantor Lectures, delivered before the Society of Arts.

† In Lecture 8, Young wrote:—"The term 'energy' may be applied with great propriety to the product of the mass (or weight) of a body into the square of the number expressing its velocity." This is not "energy" according to modern usage, but, for reasons which need not at present concern us, it is double of that to which in these days the term "energy" is applied.

Energy is from two Greek words, *ἐν*, within, and *ἐργον*, work; used in its true sense, it means the work "that is within." Whenever, then, we find that a power to do work exists, we may say, "there is energy." It needs not that the work be done, it is immaterial how long it has lain dormant, or whether it be in man's estimation great or small; we only need the assurance that there is the capacity to do. A loaded gun need not be discharged to assure us that in that which is in the gun is energy, and yet to ascertain or measure the energy the discharge must take place. When that has happened, we may say, within the gun is no energy. The gun itself is merely a contrivance by which certain combinations may be induced to exercise their energies; it has nothing to do with the communication or even introduction of the energy utilised. When the energy is within the barrel, and inoperative, we handle and play with the gun, disregarding the thought of energy, but when the energy of quiescence is to become energy in action, it behoves us to play with the gun no longer.

But how can the gun be again a means or an agent through which some one or other energy may re-manifest itself. Clearly by another group of quiescent energies being introduced. This illustration of an expended and a re-introduced energy may suffice to give a character to an element in respect of all the energies, viz. their expenditure and re-introduction or re-creation. Either through the innate operation of natural causes or through the agency of vital energy, there must be a restoration. These restorations are effected in ways to which the name of legion may be applied. For example, a weight requires energy to raise it, a spring requires energy to bend it, air in a gun requires energy to compress it, before any of these can be said to have energy in possession. The water in a mill-pond has been raised by the energy of the sun. The chemical affinities in a galvanic cell are innate. A labourer and a horse require food that they may work. So with many similar illustrations. In all these is a dormant or quiescent energy. Once let it loose and the Arabian Night's story of Sinbad and the Giant, or that boast of *Owen Glendower*, that he could

> "Call spirits from the vasty deep,"

would not be met with *Hotspur's* taunt—

> "Why, so can I, or so can any man;
> But will they come when you do call for them?"

These energies always come when rightly summoned.

Observe, energy presents itself in two forms—energy in quiescence, and energy in action. To these forms technical names have been given. Energy in quiescence is called potential energy; and energy in action is called kinetic energy. In this weight, suspended as pendulum, these two energies may be illustrated. If the weight be struck from its lowest position, then the kinetic energy of vitality as manifested through muscular action, sets it off. But if the weight be elevated and simply let fall, then the potential energy stored up in the act of lifting becomes kinetic energy, through the influence of what we call gravity.

To sum up. Belonging or attached to all that is material are certain powers or influences which cannot be separated and so weighed; hence these powers or influences are said to be "imponderable." Since these powers or influences affect the motions of bodies they are called forces, for force is that unknown influence which causes, retards, stops, or accelerates motion.

Again, when by such arrangements as nature calls into play, or men can contrive, these forces manifest themselves in action, they are said to be energetic.

Now, since we can plan to some extent how and when each force should manifest its energy, and obtain or retain the results, these results are called work. This may be measured or weighed, and it is through such work alone that a value can by men be placed upon the forces of the imponderables, which, by their energy, have done work.

The measurement, therefore, of the energies of the imponderables resolves itself into a measurement of the work they do. It is, therefore, very essential that the measurement of work should be by means easily reproducible, scientifically accurate, of universal application, beyond all question and all cavil, admitting of no elements which, under any circumstance, could vitiate or falsify a conclusion.

Three elements only are needed to fulfil these conditions, viz., the *mass* of the body moved, the *space* through which it moved, and the *time* during which by the operation of some force it was being moved. These three elements being known, all others or varieties can be derived from them; hence all others are called *derived* measurements. Reasoning thus, a pound weight from which mass may be deduced, a two-foot rule by which space may be measured, and a clock by which time may be noted, are all that we require in England in order to determine measurements of work. But very clearly these three sources of fundamental units must be of an irreproachable character. Speaking generally, who dare venture to say that the pound weight he has, or the clock he has, or the two-foot rule he has, is more to be relied upon than the corresponding instrument in the possession of his neighbour? 'Tis amusing to listen to the pleadings of the owners of watches and two-foot rules, and scales and weights, as to the wonderful accuracy of those they possess.

Where lies the appeal? Who shall decide whether the second ticked by the watch which cost thirty shillings or that ticked by the chronometer which cost one hundred pounds is to be the true second? Who shall decide the inch and the pound when the owners disagree? The answer to these questions, doubtless, raises in your minds forms of difficulties not easily solved.

It may suffice, for this evening, to glance at one or two of these difficulties, in order that we may not think it a trifling with important interests in what, perhaps, seems a kind of childish quibbling, to suggest as a difficulty in such common affairs as a pound-weight, a second, and an inch. Let us first see that from these can be had all we use as measures.

When we say of anything it measures ten, twenty, thirty, or forty, we may add the words inches, feet, yards, or miles. These words must be in some way related. The measurement thus expressed consists of two parts, a numerical and a denominational one. The numerical is absolute and independent of the denominational one. This latter is, for a special case, the unit of measurement; hence there may be a great variety of units, all, however, by their inter-relations, capable of being resolved into one. This one, this original, this is the difficult one to decide, and to it a portion of the next lecture must be given.

So far, then, for the unit of space. Now as to time. Let anyone attempt to measure time by the repetition of a unit derived from any ordinary source, and he will soon find himself in a labyrinth of doubts. All our measures of time are derived from astronomy. Of the unit of this our future grain there is the compound measure which some may say is put beyond the reach of such disparaging remarks, viz., that invaluable measure in all commercial transactions, the pound weight. Time is our own; we waste it as we please; we do not pay for it. Space is our own; we can walk where and as we please; but, as to our food, that is ours by purchase, and we buy it by the pound weight.

Well, "truth," the proverb says, "is mighty and must prevail." The pound weight is quite worthless as a scientifically accurate and universal measure. There is really no such thing as weight for a universal measure, and yet nobody ever bought a pound of sugar without thinking they were getting at one time the same quantity as at another. That is not the case. Weight, speaking accurately, is a most variable measure, and is therefore one on which no reliance is to be placed in scientific

investigation. What we do measure, scientifically speaking, when we speak of weight, is mass, and an endeavour shall be made to show you the difference between mass and weight.

First, weight is not at all to be relied upon. Here is a jar of water balanced on a scale-beam, but so as to hardly equal the weights on the other side. If I put my finger in the jar, the jar overbalances the weights. But why should the scale-pan sink when one simply touches the water with the hand? It is not pressed down. The hand is merely put into another atmosphere, water, instead of air. Lest anyone should think that the jar is pressed down, let a weight hanging by a string, which sustains the weight, be suspended in the water, still the scale pan in which the jar of water is descends. Therefore the weight appears to be altered—there seems something or other about it which is not altogether correct. The matter presents itself again in this form. Here is a scale-beam with a block of wood at one end, and an exactly balanced weight at the other. Now, as the weights pass from one atmosphere to another they change in their relationship; and whilst the mass or quantity of matter contained in this block of wood and in this counterpoising weight remains the same, yet the relation of the weights does not remain the same. Some may say that if the matter undergoes no change, then the weight undergoes no change. It is the weight which undergoes a great change, but the matter undergoes no change. At present, both are in an atmosphere of air, and you see that the beam is in exact equilibrium; but now let each be immersed in an atmosphere of water, and you see at once how the relationship to each other is changed; they no longer balance. The mass of wood is the same as before, and, therefore, as far as moving from one atmosphere to another is concerned, masses must be considered, and not weights; therefore, where the atmosphere changes, there we must give up the idea of weight. There is another cause why weight will not act as a standard unit. Weight results from the action of gravity; it is not a property of matter at all. If we change the force of gravity which tends to pull a mass down, we then change the amount of pressure that the mass exerts on a spring. If we take a mass of matter at one of the poles, it is nearer to the centre of the earth than if it were at the equator, and in consequence it will be pulled down with greater force, so that what would weigh (say) 1½lbs. by a spring balance at the pole, would weigh (say) 1¼lbs. at the equator. Therefore, if we ordered a quantity of goods to be sent from some place near the poles towards the equator, and they were weighed by a spring balance, they would not weigh so much on reaching their destination as they did when they were shipped; and yet the quantity of matter would be exactly the same.

Observe, it is a spring balance, and not a scale beam, that is used. A spring balance measures force only, viz., in this case the depressing or pulling down force of gravity at the place where it is used. With a spring balance a gravitation experiment is made. If a scale beam be used, then as the change of gravity affects the weight in each scale pan equally, the relations between them will not be affected, and the scale beam will be in equilibrium when the contents of the scales are influenced by the varying force of gravity.

You saw, a short time ago, that weight varies by taking the mass into an atmosphere denser than that in which we live, and now you shall see the same result by changing the atmosphere for one more rare. Here is a glass beaker, suspended bottom upwards by a hook, so as to exactly balance a weight at the other end of the cord; the system is now in equilibrium. I will change the atmosphere within the beaker by admitting some ordinary coal gas into it, and you see the weight changes at once; the beaker appears to be lighter. These illustrations show that dealing with weight, we deal with that which is variable in all parts of the earth, and, owing to atmospheric changes, variable at the same time almost in the same position. Doubtless all of us who have attained years of discretion have been asked the question in our earlier days, which was the heavier, a pound of lead or a pound of feathers. Here, in a glass case, is a bag of feathers (eiderdown), and a weight exactly balancing them. Call the weight a pound of lead, and then truly the pound of lead is balanced by the pound of feathers. Now, the scale beam is a delicate one, and accurately poised. By this pipe is admitted hydrogen gas into the case, the upper part of the case is closed, the hydrogen ascends, the air gradually escapes at the bottom, the scale-beam loses its equilibrium, and the bag of feathers descends, and is evidently heavier than the pound of lead.

This must for the present suffice to satisfy you that weight, as such, must not be considered an accurate measure, and that, somehow or another, a measure for mass must be obtained and used in the place of that which we call weight. These three units then—mass, space, and time—are sufficient for all purposes of measurement, and when reliable data have been furnished from whence these can be deduced, determined, and (if lost) restored, we shall be in possession of all that is required for the purpose of recording every measurement requisite for estimating and comparing the work done by the energy manifested by any one or more of the forces derived from "the imponderables."

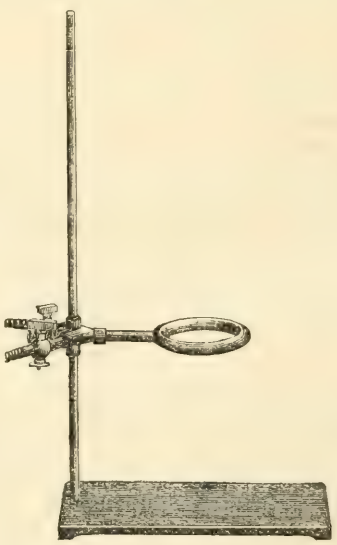
(To be continued.)

ON SOME

FORMS OF LABORATORY APPARATUS.

By WOLCOTT GIBBS, M.D.

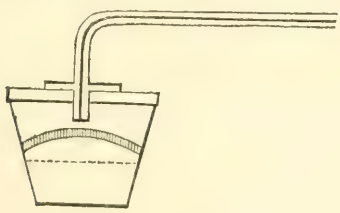
Every chemist knows how difficult it is to conduct an evaporation quantitatively in a porcelain or platinum crucible heated from beneath. The following simple contrivance which I devised some years since, and which



has long been in successful use in many laboratories in this country, deserves I think to be more widely known. It consists, as shown in the figure, of a hollow ring of metal, which can be moved up and down upon a vertical rod, also of metal, and which is provided with two stop-cocks, by means of which air and gas may be admitted to the interior of the ring in proper proportions. The ring

has a series of fine openings so placed that the little blue jets of burning gas point radially toward its centre. The common water-blast may be employed with great advantage to give a continued supply of air; and, when the proper proportions of air and gas are obtained, which requires but an instant, the little tongues of blue flame remain constant for hours. A foot-bellows may also be employed when necessary. The crucible to be heated is supported upon the bottom of an inverted Beaufsay crucible. The ring-burner is then adjusted so that the points of the little jets of flame play upon the upper edge of the crucible to be heated. After a short time the ring-burner may be lowered so as to heat a lower zone of the crucible, and so on until the outer rim of the bottom is ignited. In evaporations the ring must be more slowly lowered. With a very little practice solutions even of sodic chloride may be evaporated to perfect dryness without loss by decrepitation. Loss by the creeping of solution over the edges of the crucible is also prevented completely. In short, very numerous operations may be performed with the ring-burner more easily, quickly, and safely than by any other form of apparatus with which I am acquainted.

Another petty contrivance, which I find of great service, consists simply of a circular disc or meniscus of porous earthenware. In crucible ignitions, in which a current of gas is passed over the ignited substance—as, for instance, in reducing metallic oxides in hydrogen—great care must be taken to prevent mechanical loss. In such cases I place a porous capsule in the crucible above the substance to be heated, as in the figure. The gas may then be



introduced through the perforated cover by means of a porcelain pipe in the usual way, and passes through the porous capsule by diffusion. Mechanical loss is thus completely prevented, as the soft capsule may readily be filed so as to fit the crucible accurately.*

My acknowledgments are due to Mr. W. E. Cutter for his most efficient aid in the prosecution of my work.

CORRESPONDENCE.

ON BUTTER.

To the Editor of the Chemical News.

SIR,—I entirely agree with "J. B." in his desire for the continuance of such useful papers as the "Testing of Butter." I have been a regular subscriber to your journal for some years, and would give such thoroughly practical and really useful articles a hearty welcome.

Without expressing any opinion whatever on the paper itself, I must say it is not fair to criticise any production in a sweeping manner. Mr. Wanklyn has certainly done his best to merit "silent contempt" from his opponent; but I trust Dr. Brown will reply, without noticing the satirical strain of the critique, and defend his position as a public analyst.—I am, &c.,

W. F. CATCHESIDE.

Snodland, near Rochester.
July 16, 1873.

* As an example of the utility of this little apparatus, I may refer to Mr. R. H. Lee's paper on the atomic weights of cobalt and nickel. *Am. Jour. Sci.*, vol. ii., July, 1871.

ON BUTTER.

To the Editor of the Chemical News.

SIR,—It appears to be necessary to inform Mr. Wanklyn that the glycerides of palmitinic acid, butyroleic acid, butyric acid, &c., which are stated in the second paragraph of the paper on "Butter" (CHEMICAL NEWS, vol. xxviii., p. 1) to be the chemical constituents of butter, are the substances which Mr. Wanklyn calls palmitin, olein, butyrin, &c., in his courteous letter (vol. xxviii., p. 18).

Stearin can sometimes be obtained from butter, and sometimes not; but it does not occur in butter as crystallised stearin. When butter is fused at a low temperature the globules are still found on cooling. When it is fused at a high temperature they are not found on cooling; but the butter then has an imperfect crystalline structure, has lost its smoothness, and is very much depreciated in value: it does not exhibit crystals of stearin like those of lard and the mixture of refined fats known as "beurre de Paris," when examined by the microscope with polarised light.

No one is more sensible than I am of the imperfections of the scheme for examination of butter to which Mr. Wanklyn refers, yet I believe it is slightly better than any which has previously been published. When its results are negative, it does not prove the butter to be pure; when its results are positive, I believe they are reliable.

Mr. Wanklyn also has been working on butter; doubtless he could produce a much better method for proving admixture of refined fats with butter. Would it be too much to ask him to do so? Perhaps you, sir, would readily afford him the needful printers' ink.—I am, &c.,

J. CAMPBELL BROWN.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, June 23, 1873.

Second Note on Guano.—M. Chevreul.—In this paper the author does not give the results of a substance forming long acicular crystals, but treats of the gas disengaged by the action of water upon hard portions of guano, and of a vitreous substance taken from a sample of guano at Havre. The gas in question proved to be carbonic acid. The glassy substance had a strong ammoniacal odour mingled with that of avic acid, and consisted mainly of phosphate of ammonia. Returning to the consideration of the ultimate analysis of manures as commonly practised for commercial purposes, the author remarks that he can conceive the utility of the present system if applied to the comparison of two samples of guano; but that he cannot conceive it at all when, *e.g.*, a guano is to be compared as to its agricultural value with shoddy, bones, hair, or analogous substances. He insists especially on the power which guano possesses of giving off—when in contact with water—free carbonic acid simultaneously with the production of carbonate of ammonia. He contends that the peculiar odour of "avic acid" becoming more perceptible after that of ammonia

has disappeared, may serve as an indication as to the origin of alleged guano.

Researches on Chlorine and its Compounds.—M. Berthelot.—A thermo-chemical paper, bearing upon the controversy existing between the author and Prof. Thomsen. M. Berthelot details experiments on the behaviour of chlorine with water and with metallic proto-salts, showing what conditions the employment of chlorine in thermic measurements ought to fulfil, and throwing light on the *modus operandi* of chemical affinities. He examines the action of chlorine on water, on mercurous chloride, stannous chloride, and ferrous sulphate.

On Blast-Furnaces.—M. L. Gruner.—The author concludes—(1) That the yield of large blast-furnaces, beyond the bulk of 200 cubic metres does not increase proportionally to their capacity. (2) That up to a certain limit, variable with the state of the ore and of the fuel, there is an advantage in increasing the height of these furnaces, but that beyond this limit nothing is gained by an augmentation either of height or capacity. (3) That the minimum consumption corresponds to a mean speed of the general descent of the charge; that is to say a deficiency and an excess of the blast both equally lead to an increased consumption. In both cases there is a departure from the *optimum* progress of the furnace. (4) That the heat introduced by the hot-blast advantageously replaces that furnished by direct combustion near the tuyeres, but that the relative economy diminishes as the temperature rises higher. Beyond 700° and 800° the real economy becomes inconsiderable.

Production of Methylic Alcohol in the Distillation of Formiate of Lime.—C. Friedel and R. D. Silva.—The authors, previous to the publication of the memoir of Lieben and Paterno on the same subject, had announced to the Chemical Society (Paris) in its session May 2, 1873, that the dry distillation of the lime salt of a new valerianic acid, mixed with an excess of formiate of lime, yielded methylic alcohol. The same alcohol was also obtained by distilling the pure formiate. Formic aldehyde was probably simultaneously produced, the characteristic odour of dioxymethylen being distinguishable. During the decomposition of the formiate a considerable quantity of a gas was produced, one portion of which was absorbed by the chloride of iodine forming an oily product, doubtless chloriodide of ethylen and propylen; the portion not absorbed consisted of hydrogen. The fact above pointed out is a further instance of the analogy between those reactions which are called pyrogenous and those which take place at low temperatures: the nascent hydrogen behaves alike in both cases, and is capable of transforming by its fixation the aldehydes into alcohols.

On Tereben.—J. Ribau.—The author shows that the body commonly known as tereben is a mixture of cymen and of true tereben, the latter of which he has succeeded in isolating. It is a colourless liquid, mobile, of a faint peculiar odour. It does not congeal at −27°, and is less oxidisable than its isomer terebenthen. It boils at 155° to 156° at a pressure of 760 m.m., and its rotatory power is 0. Its composition is —

Carbon	88·24
Hydrogen	11·76
	100·00

and its formula $C_{10}H_{16}$.

Production of Rotatory Power in the Neutral Derivatives of Mannite.—M. G. Bouchardat.—The author considers that the most natural interpretation of the facts he has observed is that mannite, a substance inactive in itself, and in which no known fact warrants us in admitting any rotatory power, by what process soever it may have been obtained or regenerated, cannot be split up into several optically active substances, but acquires in its combinations with acids, or by the fact of dehydration, the power of acting upon the polarised ray. There seems thus to be a creation of rotatory power by the fact of combination.

New Researches on the Electric Effluve.—MM. Thenard.

New Series of Observations on the Solar Protuberances; New Researches on the Relation between Protuberances and Spots.—P. Secchi.—The author tabulates observations during four months, from Jan. 1 to April 22, thus completing two years. The spots and protuberances have diminished in number and size from a maximum in February to an absolute minimum observed in May, when the sun was several days without spots, and the protuberances were only five or six (being like woolly masses and without filaments). At time of writing (June 9), the activity was renewed. The author corrects M. Respighi's supposition that his interpretation of the absence of the chromosphere on the spots was only based on drawings; he was guided by direct observations. The question is, whether at these points the matter retires or advances; according to P. Secchi, it advances *(sorb)*. He has further experimented with the electric light and the absorbent power of metallic vapours. Projecting the solar spectrum on the light produced by sodium in combustion, he obtained a diffusion of the lines D_1 D_2, just as in the spots. The lines not only became broader, darker, and more diffuse, but a dark shade extended to right and left to a distance about twenty times that of the two lines. This shade he has also obtained with the spots. With iron and the electric light from a pile of fifty elements, he did not succeed in distinguishing the line 1474 K, though he counted more than 480 lines. Magnesium with the electric light gave lines greatly broadened and nebulous at the edge, and nearly touching each other, as had also been observed in a solar eruption of exceptional violence. Some lines in the blue he supposed to be from oxide of magnesium.

Influence of Atmospheric Refraction, relative to the Instant of Contact in the Transit of Venus.—M. Ed. Dubois.—A mathematical paper, with cuts.

Colouration and Greening of Neottia Nidus-Avis.—M. Ed. Prillieux.—This plant, of the family of Orchids, forms an exception to the rule that nearly all the phanerogams, having no chlorophyll, are parasites. Some time since, Herr Wiesner found that when the plant was kept in alcohol it took a green colour, which it afterwards gave up to the liquor. Hence he inferred that the exception was only apparent, the brown plant really containing chlorophyll, which, though masked, played the same part as in green plants. M. Prillieux finds that the little crystalline bodies of proteic matter, which form the brown colouration, are deformed when bathed in certain liquids, and that some liquids change both form and colour, producing the green colour. Not only solvents of chlorophyll (such as alcohol, ether, benzin), but acids (such as hydrochloric, sulphuric, nitric) and alkalies (as potash) are capable of producing the green; heat also. A slip of *Neottia Nidus-avis* put in boiling water soon turns green. If the greened plant be put in a liquor capable of dissolving chlorophyll, the characteristic properties of chlorophyll (optical, spectroscopical, &c.) may be observed. The author asks whether the chlorophyll pre-exists in the brown crystalline substance in the living plant. From some experiments he made, the conclusion seemed natural that it does not, but that when the crystalloids become green, the fact is that their substance itself is transformed into chlorophyll; not that a foreign matter, mixed with chlorophyll, is destroyed, and ceases to mask it. But he does not consider the point fully decided.

Semi-Diurnal Variations of the Barometer.—M. Broun.—These have been explained by currents of air rising from equatorial regions and going towards the poles. The writer cites some observations he made in Malabar and Coromandel, and which are against this view. Thus, in the fine season, when the semi-diurnal oscillation of

the barometer at Malabar is greatest, there is perfect stillness at 6000 feet above the sea throughout entire days. Two facts must be recognised in theorising on the variation. One is, its change with the season in Europe. It is greatest in winter, and smallest in summer. In winter, the morning minimum is more marked; in summer, the evening. The variation during the day in summer resembles that during the night in winter, and *vice versâ*. The other fact is, the change of the variation with height above the sea. From observations made by the author in India, it appears that, the nearer one approaches constant atmospheric conditions, the more nearly do the proportions between amplitude of semi-diurnal variation and total pressure approach a constant value. For places where there are not high plateaus, it may be said that, from 6000 feet, the oscillations are proportional to the total pressure for each station. The conclusions arrived at are—that the thermal hypothesis is to be rejected, and that the facts accord with the hypothesis of a polar attraction of the sun.

Study on Apparatus for Heating with Hot Air.—M. Ducrot.—From the theoretical point of view, the writer concludes that the quantity of calories furnished by the same apparatus, acting under the same conditions, is greater as the heated air issues at a lower temperature. By the same conditions, he means a constant external temperature, same quantity of fuel disposed in the same manner on the grating, burned in the same time with equal quantities of air. The.e is, however, for a piece heated with a given weight of fuel per hour, a maximum of temperature corresponding to a determinate quantity of air passing over the heating apparatus.

Constitution of the Sun and the Theory of Spots.—M. Vicaire.—Reserved for translation.

Polytechnisches Journal von Dr. E. M. Dingler, No. 3, 1873.

What should be the Composition of a Good Drinking-Water?—E. Reichardt.

An Application of Aluminate of Soda in Calico-Printing.—A. Kielmayer.

Sensibility of the Haloid Salts of Silver to Light, with Alkaline Development.—H. Vogel.

Direct Preparation of Iron from its Ores.—S. v. Tanner.

Determination of Oxygen in the Gases of Lead-Chambers.—Fr. Bode.

On Graphite.—J. Stingl.

A New Process for the Manufacture of Stearin.—M. Bock.

Archiv fur Pharmacie, May, 1873.

Preparation of Amygdalic Acid.—O. Müller.

Constituents of Cubebs, with especial reference to Cubebic Acid.—C. F. Schulze.

Photography on Dry Collodion Plates.—J. Schnauss.

Moniteur Scientifique, du Dr. Quesneville, July, 1873.

On the Determination of Phosphoric Acid in all Products of Agricultural and Physiological Importance.—M. H. Joulie.—This paper, the conclusion of M. Joulie's interesting memoir, is not available for abstraction, but will be inserted in full at an early date.

Theory of Tanning.—M. A. Reimer.—A lengthy and exhaustive paper which we shall also endeavour to give in full.

On Perfumes, from a Physiological and Commercial Point of View.—James Paton.—A memoir read before the North British Branch of the Pharmaceutical Society.

Toxicological Detection of Phosphorus.—We extract the following from a notice of Dragendorff's "Manual of Toxicology":—The detection of phosphorus can be effected by two methods: we either seek to isolate it as such, or at least to exhibit its luminous properties; or, we endeavour to find its products of oxidation other than phosphoric acid (which, of course, is naturally present in the animal body. Mitscherlich's procedure is based upon the isolation of the phosphorus by distillation and the exhibition of its peculiar light. The suspected fluids are diluted, if needful, with water, and the homogeneous mixture introduced into a flask of sufficient size. Sulphuric acid is then added. The flask is closed with a cork, through which passes a tube bent twice at right angles, 2 or 3 centimetres in diameter and 5 or 6 long, and communicating with a Liebig's condenser of glass. Heat is then applied to the flask, and the process of distillation carried on in a darkened room. Luminous vapours appear in the flask as soon as the liquid is in ebullition. These vapours gradually ascend the tube, and become almost permanent at the spot where the first drops of watery vapour condense. Fresenius and Neubauer have recognised these luminous vapours for half an hour with a solution containing 1 milligrm. of phosphorus diluted to 200,000 parts. Huseman and Marmé introduced 1 c.c. of phosphuretted oil into the stomach of a rabbit, and obtained distinct luminous indications from the contents of the stomach, the animal having been killed five hours afterwards. The distillate may contain granules of phosphorus even when none can be recognised in the matters submitted to distillation. The process, however delicate, is not applicable in all cases. Certain products of putrefaction, creosote, sulphuretted hydrogen, alcohol, ether, and oil of turpentine prevent the appearance of the luminous vapours. The phosphorus may always be detected when in quantity sufficient to separate out in granules, but the presence of these foreign bodies may mask mere traces. In such cases the distillate is subjected to a further examination. Scheerer recommends to distil in a current of carbonic acid gas, in order to prevent any of the phosphorus being lost by oxidation. By this method, however, the valuable character of luminosity is sacrificed. It may happen that all, or most of the phosphorus, has been transformed into phosphorous or hypophosphorous acid, in which case little or no luminous vapour can be detected by the above-mentioned method. The vapours of phosphorous and hypophosphorous acids reduce salts of silver, and consequently blacken filter-paper saturated with an argentic solution. This reaction is so sensitive that when it fails we may be sure of the absence of phosphorus. The converse unfortunately does not hold good, since many bodies produce a similar reaction, *e.g.*, formic acid and sulphuretted hydrogen. Hence Scheerer recommends the simultaneous employment of paper soaked in acetate of lead, which is blackened by sulphuretted hydrogen, but not by the acids of phosphorus. Fresenius and Neubauer have shown that ozone may give a brown colour to the lead-paper. It is, therefore, better to replace the lead with other test-papers prepared with nitro-prusside of sodium, arsenious acid, and chloride of antimony. The simultaneous colouration of these papers will show the presence of sulphuretted hydrogen, but will prove nothing as to the simultaneous presence or absence of the phosphorus acids. Scheerer proposes to search for phosphorus in the silver paper. It is to be washed with boiling water, the silver separated with hydrochloric acid, and phosphoric acid determined in the filtrate by means of molybdate of ammonia. It is better to dissolve the filter-paper in aqua regia. The only drawback to this process is the difficulty of procuring filter-paper absolutely free from phosphates. Dussard and Blondlot treat the homogeneous mass under examination with pure zinc and sulphuric acid. The gas generated contains phosphides of hydrogen, and burns with a characteristic green flame. The gas, before being

burnt, is freed from every trace of sulphuretted hydrogen by being passed through tubes filled with pumice steeped in potassa-lye. It should be burnt at a platinum orifice, for the yellow colouration of soda in the glass would otherwise mask the reaction. The hydrogen must not be mixed with arseniuretted or antimoniuretted hydrogen. The presence of alcohol, ether, and other organic matters is fatal to the reaction. The green colour is more distinct by daylight than in a darkened room. Blondlot has remarked that the phosphuretted hydrogen disengaged gives a black precipitate, phosphide of silver, in solutions of nitrate of silver. The phospide, placed in a suitable apparatus with zinc and hydrochloric acid, gives off a gas which burns with a green flame. In this manner he removes the organic matters which interfere with Dussard's procedure. The following is his method:—The suspected matters are converted into a homogeneous paste, and introduced into a roomy hydrogen apparatus with zinc and sulphuric acid. The gas is passed through a solution of nitrate of silver. The precipitate is filtered off, when it no longer increases in bulk, washed, and introduced into a small apparatus, and treated as above. This process occasions the loss of a part of the phosphorus. Fresenius and Neubauer have proved that merely two-thirds of the phosphorus are thrown down as phosphide of silver. These two chemists combine the two procedures of Mitscherlich-Scheerer and of Dussard Blondlot. They first employ the method of Mitscherlich, or that of Scheerer, according as there appears to be more or less of the poison present. In some cases not merely distinct luminous vapours are seen, but granules of phosphorus are isolated. As soon as these characteristics cease to appear, nitrate of silver is added to the condensed liquid, and the distillation is continued. The well-washed precipitate is introduced into the hydrogen apparatus. The purity of the zinc and sulphuric acid employed should be determined by a previous experiment. Fresenius and Neubauer have analysed a liquid (putrid blood and water), containing 1 milligrm. of phosphorus in 200,000. The first 400 c.c. of hydrogen presented the most characteristic reactions. The colouration was more feeble with the 400 next, and very faint but still perceptible with the 400 last. Christoffe and Beilstein recommend the examination of the flame with the spectroscope. The residue of the distillation may contain phosphorous acid formed by the oxidation of the phosphorus. It may be treated with zinc and sulphuric acid. Phosphoric acid is never decomposed in these conditions. The contrary is the case with the hypophosphites, which, being latterly employed in medicine, may be the cause of errors.

Clarification of Beer by means of Tannin.— E. Brescius.—For 1000 litres the author employs about 140 grms. of tannin, dissolved in 0·75 litre of water, which is thoroughly stirred up. After three or four days he adds 1 litre of isinglass or 2 of gelatine in the proportion of 1 kilo. to 100 litres. The complete clarification requires about eight days.

On a New Method of Dyeing and Printing with Indigo.—P. Schutzenberger and F. de Lalande.—The energetic reducing action of hydrosulphite of soda, and its almost instantaneous influence upon indigo, which it converts in the cold into white indigo, has led the authors to study the practical employment of this salt in the various applications of indigo in dyeing and printing. The vats most commonly employed in modern times are the copperas vat for vegetable fibres, and the fermentation vat for wool. The chief inconvenience of the former is the presence of a bulky precipitate of oxide of iron and of sulphate of lime, which have to settle before the clear liquid can be used for dyeing. Fermentation vats are difficult to manage, and liable to sudden changes, which may in a few hours involve the loss of all the indigo contained. The hydrosulphite vat which the authors propose, as well for animal as vegetable fibres, is set as follows.—Bisulphite of soda, standing at 30° to 35° Baumé, is brought in contact in a covered vessel with twisted sheet zinc or granulated zinc, filling up to the top of the vessel without occupying more than one-fourth of its real volume. After the lapse of about one hour the liquid is poured into an excess of milk of lime, which precipitates the salts of zinc. It is stirred, and the clear liquid drawn off either by filtration and pressure, or by decantation after the addition of water. Air should be excluded as much as possible. By mixing the hydrosulphite thus obtained with ground indigo and the amounts of lime or soda needful to dissolve the reduced indigo, we obtain at once a yellowish liquid containing no insoluble matter except the earthy impurities of the indigo. One kilogramme of indigo may be thus reduced so as to form a solution not exceeding 10 to 15 litres in volume. For dyeing, a certain quantity of the reduced indigo solution is run into a vat filled with water. This vat being clear in its entire depth, the operation of dyeing involves no loss of time. The excess of hydrosulphite constantly reduces the scum of oxidised indigo forming on the surface of the dye-bath, the strength of which can be kept up during working by successive additions of the concentrated indigo solution. Thus the required shade can be obtained with the smallest possible number of dips. This vat gives shades more solid and clear than can be obtained with the old vats, and enables the dyer to produce upon wool very light blue bottoms, which are ordinarily got by means of sulphate of indigo, and are in consequence much more fugitive. The process at present employed for printing indigo-blues consists in printing on white indigo, or indigo-talc of tin, obtained by precipitating a tin vat with hydrochloric acid, or by adding to the clear portion of a copperas vat a mixture of tin-salt and hydrochloric acid. The precipitate, thickened with gum, is printed on the calico, and then fixed with milk of lime. The goods are next passed through a chloride of lime bath, sulphuric acid, and soap. The process is difficult, delicate, and costly. Various attempts at improvement have hitherto failed in securing complete success. We may mention as examples the faiencé blue, pencil blue, and printing with a concentrated vat in an atmosphere of coal gas, air being excluded. The authors propose to print with an alkaline solution of reduced indigo, suitably concentrated and thickened, containing a large excess of hydrosulphite of soda. The presence of this salt tends to keep the indigo-blue reduced which otherwise tends to become oxidised during the time of printing. This part of the process can be carried out in common air, and with an ordinary machine, the oxidation being so slight that after an hours' work the remnant of the colour is still yellow and soluble. By thus printing on reduced indigo immediate fixation is secured, and entire colouring matter is utilised. Experience has proved that, for equal shades, 50 to 60 per cent less indigo is consumed with the new process than with the old. The shades obtained are more beautiful and solid, and the impression is better defined. The new indigo blue, requiring no subsequent fixing process, can be printed along with a great number of other colours, such as aniline black, garancin, colours obtained by dyeing or steaming, catechu shades, chrome colours, colours fixed with albumen, &c. Thus new styles may be created which would be difficult to execute in any other manner. The blue printing colour is formed by thickening with gum or any other suitable material, a sufficiently concentrated solution of white indigo in an alkali, and adding to the mixture a sufficient quantity of hydrosulphite of soda. After printing, the pieces are hung up for twenty-four hours to oxidise, washed and soaped.

Revue Scientifique de la France et de l'Etranger,
July 5, 1873.

This number contains no chemical matter.

Neues Repertorium fur Pharmacie, No. 5, 1873.

Valuation of Bone-Black.—J. B. Schober.

Solubility of Arsenious Acid in Water.—L. A. Büchner.

Autumnal Colouration of Leaves, and the Manner of Formation of Vegetable Acids.—C. Kraus.

Researches on Kirschwasser.—G. Brigel.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Mène, No. 25, April 25, 1873.

This number contains nothing bearing upon chemistry

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvement in the manufacture of the phosphates of soda and potash, and chloride of ammonium; also in the manufacture of chemical manures and alkalies. Robert Storr Best, Goole, Yorkshire. December 5, 1872.—No. 3687. I take phosphoric acid, derived either from aluminous phosphates after the extraction of alum or from other sources, and in definite proportions mix with potassium or sodium chloride, then saturate with ammonia, either from distillation of gas-water, or the destructive distillation, with lime, of wool refuse, leather, horn shavings, or other nitrogenous substance. I then evaporate to crystals or dryness, and use the product at once as a highly concentrated manure, or recover the ammonium chloride by crystallisation or sublimation, leaving the potassium or sodium phosphate to be dealt with. I then, from a solution of the alkaline phosphate, precipitate tribasic phosphate of lime, by the addition of lime to the solution, having potash or soda remaining, which I evaporate to dryness. I then treat the precipitated phosphate with a further quantity of phosphoric acid, forming monobasic phosphate, dry by mixture with calcined gypsum or salt of magnesia, and thus produce a very concentrated superphosphate of lime.

An improved apparatus for drying sewage precipitates, cement, paper pulp, and other fluid or semi-fluid matters. William Hart and James Hart, Crossness, Kent. December 9, 1872.—No. 3734. This apparatus consists essentially of a revolving drum (the cylindrical part of which is perforated or reticulated) and other apparatus in connection therewith, such drum and apparatus being arranged as hereinafter described so as to separate the water from the matter to be dried and draw a coating of such matter on to the periphery of the drum, then to draw hot air through the coating to dry it, and then to force cold air through the dried matter to detach it. The drum consists of two discs mounted on a horizontal shaft, wire gauze being affixed to the edges of the disks to constitute strainers. The lower part of the drum works in a tank containing the matter to be dried. The upper part (except at the part where the dried matter is detached) is covered by a hot air casing into which hot air is introduced by a pipe leading from the heater to a trough affixed to the casing. The drum is divided into a series of longitudinal chambers which communicate with ports in a cylinder keyed on the drum shaft and outside the drum. This cylinder revolves in a stationary outer cylinder of such a diameter as to leave an annular space between the two cylinders. This annular space is divided into three chambers, termed respectively the water exhaust chamber, the hot air exhaust chamber, and the blast chamber. The water exhaust chamber communicates with a suction pump which draws the water through those of the chambers which are immersed in the matter to be dried, and causes a coating of such matter to adhere to the drum. The water drawn into the chambers is drawn therefrom through pipes and ports which communicate with the water exhaust chamber. The hot air exhaust chamber communicates with a suction pump which draws hot air through those of the longitudinal chambers which are passing under the hot air casing, and thereby dries the coating of matter on the drum. The blast chamber communicates with a forcing pump which forces air through the longitudinal chamber in communication with the said blast chamber, which air tends to loosen or detach the dried matter from the drum. A brush or scraper is mounted on this part of the drum to complete the removal of the matter.

An improved insulating compound for telegraphic purposes. William Robert Lake, of the firm of Haseltine, Lake, and Co., patent agents, Southampton Buildings, London. (A communication from Zalmon G. Simmons, Kenosha, Wisconsin, U. S. A.) December 9, 1872.—No. 3736). This invention relates to a composition of materials producing an insulating compound by means of which a more perfect insulation of telegraphic conductors is obtained than by the ordinary means; this compound is at the same time cheap and durable, and is not easily affected by the action of the weather. This compound is composed of one part coal-tar or its equivalent, and two parts charcoal or saw-dust, tan bark, or any other organic body having a fibre and being a poor conductor of electricity, and which may be ground or cut up to mix with the tar. The coal-tar is brought to a boiling temperature when the charcoal is introduced and thoroughly combined with it by agitating the entire mass by any mechanical means. The proportions may be varied.

An improved method of clarifying and settling varnishes, oils, and other like substances. William Robert Lake, of the firm of Haseltine, Lake, and Co., patent agents, Southampton Buildings, London. (A communication from Franklin Kersting, Grand Rapids, Michigan, U. S. A., grainer and polisher). December 9, 1872.—No. 3737. I take oyster shells, burn them well, and grind them to a fine powder. I then grind marble chips and dust to a powder also. These are thoroughly mixed together and thrown into a vessel containing the liquid. The mixture is then allowed to stand forty-eight hours, during which time all the dirt, motes, and gum specks of the liquid are precipitated to the bottom of the receptacle, and a new and improved varnish or article is thus produced for the trade.

Improvements in the treatment and utilisation of sewage water. Henry Young Darracott Scott, Ealing, Middlesex, Major-General, C.B. December 11, 1872.—No. 3755. The objects of this invention are, economy in dealing with sewage, the effectual cleansing of the drains, and the preventing the generation of noxious sewer gases.

*A new or improved motive-power engine actuated by soluble gasses.** William Edward Gedge, patent agent, 11, Wellington Street, Strand, Middlesex. (A communication from Georges Thomas de Kercado, 64, Faubourg St. Martin, Paris). December 12, 1872.—No. 3766. This invention relates to a motive-power engine actuated by soluble gasses, such as chlorhydric acid gas, ammoniac or metillyac gas, or any gas having the property of dilating at a low temperature and condensing with equal facility. The soluble gas separates itself in a heated generator from the liquid which had dissolved it, and passes into a reservoir, from whence it is distributed to the cylinders, after acting upon the pistons of which it passes into a condenser, there re-uniting with the absorbing liquid, which, forced by the gas from the generator, has passed through a jacket surrounding the gas-reservoir, and from thence to the condenser. After complete absorption of the gas by the liquid, the solution made in the condenser goes to a receiver, and from thence to the generator, where the seperation again takes place, the gas and liquid again make the same circuit, and so on indefinitely.

Improvements in the means and apparatus for conveying sewage and other liquid or partially liquid refuse from cesspools, privies, and other receptacles. Charles Denton Abel, 20, Southampton Buildings, Chancery Lane, Middlesex. (A communication from Alexander Frederick Booroff, St. Petersburg, Russia). December 13, 1872.—No. 3788. This invention relates to the arrangement, construction, and operation of apparatus for emptying cesspools and receptacles of excreta and other refuse and conveying the contents by pipes to localities where they may be discharged or utilised without permitting the escape of offensive emanations. For this purpose a system of pipes provided with valves is arranged underground communicated with the cesspools and other receptacles for sewage and other refuse, and leading to a discharging apparatus consisting of a well or shaft in which is a vertical stand pipe communicating with the system of pipes and with an air-pump or other apparatus for producing a vacuum. By the action of the stand pipe and the exhausting apparatus the sewage is made to flow down into the well, whence it is removed by a dredging machine or chain buckets. At the highest points of the sewer pipes closed reservoirs are connected thereto, in which the foul gases accumulate, and from which they are conducted to burners for consuming them. The sewer pipes are connected with the water mains for the purpose of filling them with water at starting, and for flushing the pipes when required.

Improvements in the manufacture of hydrogen gas. James Frederick Lackersteen, civil engineer, 3, Lombard Court, London. December 17, 1872.—No. 3829. The specification of this invention describes a method of manufacturing hydrogen gas by passing steam, superheated or otherwise, through or over heated manganese, or any suitable compound thereof, by which means the steam is decomposed, the oxygen being absorbed by the manganese, and the hydrogen set free, to be conveyed away by suitable means, and used for whatever purpose it may be required.

NOTES AND QUERIES.

Lemon-Chrome.—(Reply to L. C.)—I think if L. C. adds a little potassic carbonate to the chromate before mixing with the lead solution it will give the desired shade. Perhaps the chromate of potass used was not quite neutral; this would render it so.—H. C.

Chrome-Yellow.—Can any of your readers inform me what substitute can be used for nitrate or acetate of lead to precipitate bichrome of potash yellow? The Germans are now making a yellow pigment without using lead, and if you can put me upon the track I shall feel obliged.—COLOUR.

Anthracen.—I shall feel greatly obliged if any of my fellow readers will inform me of a good reliable method for estimating the percentage of anthracen in commercial samples. I am acquainted with the method by use of methyl-alcohol, but experience great difficulty in purifying very crude samples. Also, if I could be informed of the colour of pure anthracen, and correct fusing-point I should be obliged.—D. W.

Safety at Sea.—The recent sudden destruction of two large passenger ships, the *Atlantic* and the *City of Washington*, has called attention to the desirability of availing ourselves of the means which modern science has placed at our command for the prevention of such disastrous accidents. For this purpose, each large passenger ship should carry a small, but powerful steamboat or launch, and in foggy weather this steam launch should be sent on ahead some few hundred yards, being connected with the passenger ship by a flexible telegraphic cable provided with an electric battery, so that signals or messages might be continually transmitted from one to the other. The steam-launch should also carry an electric or other strong light, and be provided with a powerful steam whistle. On meeting with ice or with vessels, or unexpectedly approaching the coast, it would be comparatively easy to stop the steam-launch and give warning in time to save the passenger ship from danger.—JOHN NEWLANDS, F.C.S.

* The spelling is the patentee's.

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THE CHEMICAL NEWS.

VOL. XXVIII. No. 713.

THE POLLUTION OF RIVERS BILL.

THE Earl of Shaftesbury has presented to the legislature a Bill, bearing the above title, and embodying the water-clauses, which were struck out of the Public Health Bill before it became law last session.

As will be remembered, serious objections were raised against that portion of the Public Health Bill which relates to the Pollution of Rivers, and Mr. Stansfeld was so convinced of its impracticability that he publicly repudiated it, and excused the Government at the expense of the Rivers' Commission.

On behalf of the great majority of English chemists we protest against the resuscitation in the House of Lords of recommendations of the Rivers' Commission, which were expunged from the Public Health Bill, and repudiated by a responsible minister of the Crown.

These recommendations are as follows. We quote them from the printed draft of the Earl of Shaftesbury's Bill, which lies before us.

"Clause 7. For the purposes of this Act the following liquids shall be declared to be polluting (that is to say):—

"(1). Any liquid containing in suspension more than 3 parts by weight of dry mineral matter, or 1 part by weight of dry organic matter, in 100,000 parts by weight of the liquid:

"(2). Any liquid containing in solution more than 2 parts by weight of organic carbon, or 0·3 part by weight of organic nitrogen in 100,000 parts by weight of the liquid:

"(3). Any liquid which exhibits by daylight a distinct colour when a stratum of 1 inch deep is placed in a white porcelain or earthenware vessel:

"(4). Any liquid which contains in solution in 100,000 parts by weight more than 2 parts by weight of any metal, except calcium, magnesium, potassium, and sodium:

"(5). Any liquid which in 10,000 parts by weight contains, whether in solution or suspension in chemical combination or otherwise, more than 0·05 part by weight of metallic arsenic:

"(6). Any liquid which, after acidification with sulphuric acid, contains in 100,000 parts by weight more than 1 part by weight of free chlorine:

"(7). Any liquid which contains in 100,000 parts by weight more than 1 part by weight of sulphur in the condition either of sulphuretted hydrogen or a soluble sulphuret:

"(8). Any liquid possessing an acidity greater than that which is produced by adding 2 parts by weight of real muriatic acid to 1000 parts by weight of distilled water:

"(9). Any liquid possessing an alkalinity greater than that produced by adding 1 part by weight of dry caustic soda to 1000 parts by weight of distilled water:

"(10). Any liquid exhibiting a film of petroleum or hydrocarbon oil upon its surface, or containing in suspension in 100,000 parts more than 0·05 part of such oil."

The Bill proposes to punish persons who discharge into streams, liquids answering to the above descriptions. When this matter was under discussion last year the futility of merely estimating the strength of a discharge was pointed out, and it was shown that the effect of such a course would be to put manufacturers to inconvenience and inflict injury upon them. And, as will be remembered, deputations of manufacturers waited on Mr. Stansfeld, to urge upon him the damage which would be done to the industries of the country if the Bill, in its unamended form, came into operation.

We will now take up the subject of the definitions of what constitutes a polluting liquid, and show how injudicious are the above-quoted recommendations, and how impossible it will be to attend to them in practice.

According to the first definition in Clause 7, no liquid must flow into a river if it has suspended in it more than 3 parts of mineral matter in 100,000.

We remind our readers that the Thames sometimes contains 50 parts of suspended matter in 100,000; the Rhine at Bonn 20; the Meuse 47; the Ganges 20 to 200; the Seine 12; and the Mississippi 80. The last river is said to carry down annually to the sea no less than 4000 million cubic feet of clay.

As was pointed out by the Marquis of Salisbury, any ditch draining into a river might entail penalties on landowners, provided the water in the ditches was not purer in this respect than some of the greatest rivers in the world. Indeed, the Bill would entail the penalties on the owner of *one end* of the ditch.

Definition 2, prohibits more than 2 parts of "organic carbon," or 0·3 part of "organic nitrogen" in 100,000 parts of the discharge. Let us examine this.

London sewage consists mainly of the day's excreta mixed with 30 gallons of water per individual. Taking the day's urine to be 3 lbs. (which is rather a high average), it would, therefore, appear that the urine is diluted with 100 times its weight of water, in order to make London sewage. Urea is very rapidly transformed into carbonate of ammonia, and sewage contains little or no urea, but instead of it the carbonate of ammonia arising from its transformation. In addition to urea, urine contains other nitrogenous matters which are comparatively permanent, and which pass undecomposed into sewage. Now it is a fact which admits of deduction, and which has likewise been confirmed by experiment, that London sewage—such as is discharged by the Fleet Ditch sewer and at Barking—does not contain more organic nitrogen than 0·3 part per 100,000.

No evidence has been laid before the public, or the scientific world, as to the precise numerical limits adopted in the definitions; nor proof that the evil effects of the various impurities specified stand in the exact proportions implied in Section 7. Where is the proof that "organic nitrogen" is safe up to the limit specified, and unsafe beyond? Failing such proof, the recommendations savour of empiricism, wearing the mask of scientific precision.

The use of the terms "organic nitrogen" and "organic carbon" is objectionable, because it implies an official recognition of the process of water-analysis devised by one of the Commissioners, but condemned by the chemical profession as impracticable and fallacious.

The term "organic nitrogen" confounds substances totally distinct in a sanitary point of view. Thus it would include—

a. Bodies such as *urea*, which is resolved on decomposition into carbonate of ammonia, and which is no more dangerous to health than pre-formed ammoniacal salts, or alkaline nitrites and nitrates.

b. Bodies like the organic alkaloids, which obstinately resist putrefaction.

c. Bodies like albumen, gelatin, casein, &c., which rapidly pass into the most offensive phases of decomposition.

To group under one head two bodies so utterly dissimilar in their sanitary bearings as urea and albumen, merely because they both contain nitrogen, is to violate the fundamental laws of scientific classification. Any regulation which ignores such important distinctions must be misleading and dangerous. It is therefore suggested that for the term "organic nitrogen" the more precise term "*albumenoid ammonia*" should be substituted; that is to say, nitrogen present in the form of albumenoid bodies, estimated by the amount of ammonia which they yield.

Similar objections must be taken to the term "organic carbon." It, also, confounds bodies incapable of putrefaction with others exceedingly liable to change, and certain to yield offensive products. Thus, should *alcohol* enter a river, it would neither putrefy nor aid in the multiplication of germs, whilst *starch* would do both. Yet these two bodies would be grouped together as yielding organic carbon.

The third definition would exclude probably all ditches and small brooks, most mountain streams, and many of the most beautiful mountain tarns, for they are frequently sufficiently tinged with peaty extractive matter to succumb to this test. Indeed we are not certain that the water of Bala Lake, from which London was to have been supplied, would always pass this ordeal. Constant disputes would be caused by the impossibility of deciding what was a "distinct colour." One authority would certainly prohibit what another would allow to pass; and if, as we understand is the case, it was the intention of the Rivers' Pollution Commissioners, in drawing up their regulations, to make this clause sufficiently lenient to pass a peaty stream which has the appearance of coffee when viewed in a stratum a foot thick, we can only say that they made a most unfortunate choice of language in which to express their meaning.

Definition 4 is levelled against noxious metals. With the exception of potassium, sodium, calcium, and magnesium on the one hand, and of arsenic on the other, this regulation places all metals on an equal footing. No more stringent rule applies to poisons—such as copper, lead, chromium, &c.—than to aluminium and iron, which are practically harmless. Copper, lead, chromium, &c., should be prohibited as strictly as arsenic. Iron and aluminium occur in many natural springs to a greater extent than these definitions would permit. There is no valid reason why all metals except calcium, magnesium, potassium, and sodium should be excluded if they exceed 2 parts in 100,000. What, for instance, is the objection to strontium? And why should barium, chromium, lead, and copper, all well-known and formidable poisons, be permissible in any amount below 2 parts in 100,000 of water? There is no special provision against the admission into streams of *phosphoric acid*, which, though innocent in itself, powerfully aids in the promotion of putrefaction and in the multiplication of the lower forms of animal and vegetable life.

Definition 6 certainly requires qualifying. In a clear stream, abounding with fish and water plants, a little chlorine might be an objection. But, considering the filthy state in which most of our large rivers find themselves, we think the endeavour at present should be to induce manufacturers to throw as much chlorine *into* the river as they are willing to waste, and not to fine them unless they keep it out.

The "definitions," whilst laying down rules for the *strength in noxious matter* of any sewage, &c., flowing into a river, totally overlook its *volume* and the ratio it bears to the volume of the river. By this oversight the whole scheme may be entirely stultified, for it is evident that a million gallons of waste liquor thrown into a good sized river may do less harm than a thousand gallons discharged into a small stream.

Again, the act will be easily evaded where it is of most consequence it should be strictly enforced. Take the case of two large manufacturers, A and B, each discharging the same volume and quality of polluting liquid into a river. Let A be situated at the head of a stream, taking the water pure and undefiled as it gushes from the mountain side. Here, if any where, the proposed act should be stringently operative, for any offensive liquid thrown into the river pollutes it throughout its whole course. Accordingly clause 10 of the Act is put into operation, and the offending manufacturer receives written notice from the pollution authority to discontinue the discharge of polluting liquid within twelve months. What will the manufacturer do? He will merely divert a little more of the mountain stream into his works, dilute his waste liquors with the pure water down to the requirements of the law, and snap his fingers at the Act of Parliament. Now it is obvious that such a procedure, though it would literally fulfil the law, would leave the stream as polluted as before, since the total amount of impurities thrown into it would remain undiminished, and would bear the same ratio to the volume of water in the river.

But his fellow transgressor, B, situated 50 miles below on the same stream, will be unable to evade the penalty in this easy manner. His waste liquors, it is true, do not come up to the specified standard of purity; but as the river into which he drains has already passed through three or four large towns, and received the waste liquors of some hundreds of manufactories, it is even less able to conform to the Act. Here the waste liquor discharged by B actually does good rather than harm, inasmuch as it is less impure than the river into which it flows. It is obviously out of B's power to adopt the artifice employed by A, and he accordingly gets fined although his waste liquor is better than the river into which he discharges it, and he cannot therefore dilute it down to the required strength.

Instead of fixing upon a fanciful standard of purity which could never be attained in practice, common sense decides that a waste liquor is fit to be discharged into a running stream if it contain a less percentage of impurity than the water of that stream: the word "impurity" being not strained beyond its

legitimate meaning, or made to include perfectly harmless constituents. A manufacturer at the head of a stream would, it is true, have some difficulty in complying with this requirement, but it would only be fair that one drawing pure water near the source of a river, and then polluting that river throughout its whole course, should be judged by a severer standard than if he were to do exactly the same thing fifty miles below, where the river water, as he received it, was already polluted.

In the case of the highest, one or two works on a river the above rule would fail, and some modification must be introduced; but it would not fail until the natural working of the rule had so far purified the rivers of England as to have carried out, to all intents and purposes, the objects of the proposed Act.

Another great advantage of some such elastic, self-regulating rule as the one sketched out above would be that its action would be gradual. The purification of a river would take place by imperceptible gradations, extending over perhaps a year or two, without pressing hardly on any one. In this way time would be allowed manufacturers for making arrangements to purify their waste liquids; and as the river gradually increased in purity by the natural working of these regulations, we have little doubt that the progress of science, and their own increased experience, would enable manufacturers in almost all cases to keep their effluent liquids up to the necessary standard.

COMPARISON OF BUTTER WITH OTHER FATS.

By J. CAMPBELL BROWN, D.Sc.

THE proportions of the chemical constituents vary so greatly (from zero upwards) that no reliable evidence of purity or impurity can be obtained by estimating the different fats obtainable by decomposing butter. In fact, the distinction between pure butter and butter mixed with flesh-fats is no more a chemical one than the distinction between different animals or different plants. The physiologist distinguishes one kind of tissue from another more readily by their microscopic characters than by their chemical composition; and microscopic examination with polarised light is the most reliable means of distinguishing pure butter from that which contains an admixture of less easily digestible and less palatable fats.

Designation.	When Heated: Softens at Fahr.	When Heated: Melts at Fahr.	On Cooling: Obscures reading.	On Cooling: Stem indistinct.	On Cooling: Stem invisible.	On Cooling: Solid at Fahr.
No.	°	°	°	°	°	°
10. Newly-made butter, from town-fed cows	69	76	83	76	73	62
The same salted ..	69	75	83	75	74	62
8. Irish butter	75	89	73	71	69	62
4. Irish butter, best quality	69	80	78	74	71	66
99. Irish butter, low quality	76	89	82	77	74	69
1. Cornish butter ..	72	80	80	78	72	58
6. Canadian butter ..	74	90	71	69	68	66
60. Canadian butter ..	73	89	72	70	68	66
5. Kiel butter	75	90	74	72	71	70
47. Suspected butter ..	81	96	106	84	76	73
11. Lard	84	96	—	—	99	85
7. Lard	79	87	80	79	76	68
14. Lard	87	96	80	79	78	74
2. Palm oil	81	92	—	8	80	69
3. Stearin from palm-seeds (is really palmitin)	83	88	95	93	88	79
Stearin from tallow	105	113	95	94	93	92
Butter with 20 per cent lard	82	90	86	82	76	71
Butter with 20 per cent tallow. Stearin free from taste	88	99	79	77	76	73
Butter with 50 per cent dripping ..	82	93	92	81	75	71

Examined by a Microscope with a ¼-inch Object-Glass with Polarised Light and Selenite Plate.	Curd and Salt in grs. per oz.	Deposit from 3 ozs. Ether at 65°: Weight in grs. per oz.	Deposit from 3 ozs. Ether at 65°: Fuses at Fahr.	Deposit from 3 ozs. Ether at 65°: Solidifies at Fahr.
			°	°
Nothing is seen except globules and curd.	—	2·6	137	118
Globules, particles of curd; cubical crystals of salt.	32·5	—	—	—
Globules, curd and salt; does not polarise. After being kept for nine months does not exhibit any crystals which polarise light.	—	1·7	133	114
Globules, curd and salt. After being kept for eight months, exposed to sun, is white, but contains no crystals which polarise light; nor after being melted.	36·8	3·0	134	115
—	17·7	19·1	131	105
—	24·1	8·6	129	110
Globules, curd; large crystals of salt, very numerous. The only things visible which polarise light are a few hairs and fibres. After being kept a year, exposed to changes of temperature and light, exhibits the same characters.	39·9	2·4	130	105
Globules, curd; large and numerous crystals of salt; magnesium salts; a few fibres. After eight months is decomposing, but contains no fat crystals which polarise light.	48·9	9·0	125	110
Globules, curd, and small crystals of salt. Is highly coloured. After eight months presents the same characters. Does not polarise light after being melted and cooled.	24·9	12·2	120	102
Globules, curd; cubical crystals of salt; stars and other crystals of fat which polarise light.	15·6	7·0	122	102
Stellar and fusiform crystals which polarise light.	—	—	—	—
Full of crystals which polarise light.	—	3·6	128	102
Stellar masses which polarise light.	1·3	62·7	123	100
Corpuscles and radiating masses of crystals which polarise light.	—	None from (temp. 60°). None from 2 ozs.	—	—
Crystals which polarise light.		None from 2 ozs.	—	—
Stars and radiating masses of crystals which polarise light.	—	1·1	134	121
Globules, curd; salt; broken stars which polarise light.	31·9	2·7	128	98
Globules, curd; salt, and minute stars which polarise light.	24·7	55·3	135	115
Globules, curd; salt; colouring matter; stars and other crystalline particles which polarise light.	19·0	43·8	136	113

A NEW THEORY OF THE FIELD OF VIEW AND MAGNIFICATION OF OPTICAL INSTRUMENTS.

In a recent number of *Poggendorff's Annalen*, Prof. Lubimoff, of Moscow, calls attention to an error which has long passed current in text-books on physics. It is generally said that the field of view of the Galilean telescope is dependent on the size of pupil of the observer's eye, and is measured by the angle subtended by the pupil's aperture from the middle of the objective. In this way it is represented as being five or six times less than it actually is. He quotes from various text-books, those of Wüllner, Pouillet Müller, Reis, Daguin, Potter, and others, in illustration of his statement.

The error he traces to Euler, who wrongly applied to the case of a concave eye-piece, a principle which holds good in the Keplerian telescope. The central rays diverge from the centre of the object-glass, as from one point, and are united in a point where the eye-piece, if a convex lens, gives an image of the aperture of the objective. If the eye is in this position, it receives all central rays which fall on the eye-piece; hence the latter operates with its whole aperture. As, with a concave eye-piece, the central rays diverge, the eye, when applied to it, receives only so many rays as pass through the aperture of the pupil. This remark, the Professor points out, is quite correct with reference to central rays, but does not warrant a conclusion as to the field of view, for a considerable portion of the image on the retina is formed without central rays, and only by the side parts of the object-glass.

We propose to follow the author in the elucidation of his views on this subject.

To understand the true theory of the phenomenon, it may be well to resort to a principle which is often of use in explaining the elementary theory of images. This is, that we regard the image-forming apparatus (lens or mirror) as an aperture or a window, and the image itself as an object placed behind the aperture, and looked at through it. Apply this principle to the Galilean telescope. When we look through the telescope we see a bright circle before us, in which several objects appear, and which plays the part of the supposed window. What is this circle? It is easy to understand that it is no other than the subjective image of the object-glass aperture, produced through the dispersive eye-piece. (The size of the diaphragm may here be regarded as identical with that of the subjective image.) As, now, from the middle point of a lens, every object is seen under about the same angle as its image, we may take as approximate measure of the angular size of the diameter of the bright window (the eye being at the optical middle point of the eye-piece), the quotient obtained by dividing the diameter of the objective from the eye-piece, say $\frac{D}{\Delta}$; Δ being, according to the theory of the telescope, equal to the difference, $F_1 - F_2$, the focal distances of objective and eye-piece. Expressed in angular measure, the quotient will be—

$$\frac{360}{2\pi} \cdot \frac{D}{F_1 - F_2}$$

If we looked at the object through a window of the same angular size as the bright circle with the naked eye, this number of degrees would directly express what is the greatest part of the entire circle of external objects we can see at once. To determine this practically it might be well to remove objective and eye-piece, and, without altering the position of the eye, look through the empty tube. Now, as the telescope magnifies n times, *i.e.*, brings the object, so to speak, n times nearer to the eye, we shall, *with the telescope*, view through an aperture of the same visible size as formerly, an n times smaller part of the external circle of objects. To find the true field of view of a Galilean telescope, therefore, the above expression must be divided by n, or by $\frac{F_1}{F_2}$; as, according to telescope theory, n is about equal to this proportion. Hence the field of view is—

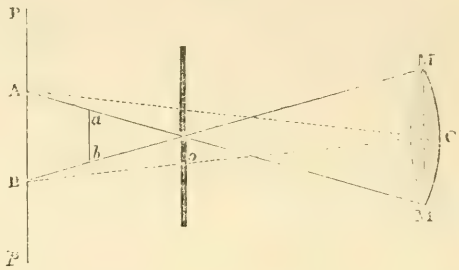
$$\frac{360^\circ}{2\pi} \cdot \frac{D}{F_1 - F_2} \cdot \frac{F_2}{F}$$

The relation shown to exist between field of view and magnification affords a ready method of estimating the latter. One has only to look with the naked eye through an aperture, whose visible size is equal to that of the bright circle, and to compare the included space with that seen through the telescope (*e.g.* to count how many windows in a building, seen through an aperture, and seen through a telescope).

The theory asserts that the field of view of a Galilean telescope is immediately dependent on the size of aperture of the objective.

It can be shown what part of the objective shares in the production of a given part of an image, and the following mode of doing so gives a new point of view as to the theory of the telescope. Let M M (Fig. 1) be the objective, P P its focal plane, in which distant objects are imaged. Bring between the objective and the plane a diaphragm with small opening. The image will be formed as before; only that each point of the image is no longer produced through the union of all the rays of a conical bundle, having the whole objective as its base; but only by that part of the bundle which passes through the small opening, and may be regarded as a single ray. Thus, for a given point of the image, only that small part of the objective will send rays which correspond to the straight line going from said point through the opening to the objective. The limits of the image will be determined by the lines M A and M B. Now, substitute for the diaphram a Galilean eye-piece, behind which is the observer's eye. The phenomenon is in its main features the same; for we may regard the eye as a dark chamber, on whose further wall (the retina) the image is formed. The optical part of the eye and the eye-piece merely serve to make the retinal image distinct, and may, for theoretical treatment, be replaced by a lens fixed in the widened part of the diaphragm (*m m*, Fig. 2). The difference between the action of such a lens and that of

FIG. 1.



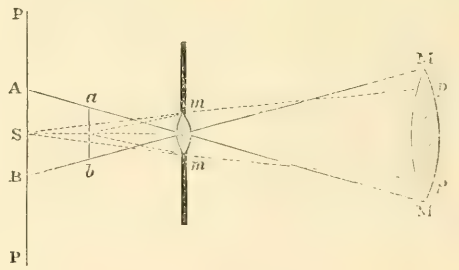


FIG. 2.

the small opening lies in this, that the image is distinct in the former case only when the screen stands at a particular distance, and that nearer to the lens than its focal plane, P P, *e.g.* at *a b*. And the same angle will correspond to both images. That part of the objective which shares in the production of a given image-point, will be determined by the lines drawn from said point to the edges, *m m*, of the lens, and prolonged thence to the objective. Corresponding to the contour of the supposed lens, we must evidently take the pupil aperture of the observer's eye. Let E be the diameter of the pupil, x that of the operative part, *p p*, in the objective, the size of this latter will be determined approximately by the equation—

$$\frac{x}{F_1} = \frac{E}{F_2}$$

The foregoing contains the entire theory of the Galilean telescope. The retina is the flame which receives the image, *a b*. As this image is inverted, like all retinal images, we see the objects upright. The visual angle, under which the part of the visible circle imaged in *a b* appears, is determined by the lines drawn from the middle point of the lens, *m m*, to *a* and *b*, or (the same thing) to A and B, and is measured by $\frac{AB}{F_2}$. The visual angle under which the same portion of visible space would appear to the naked eye, supposing this to be at the middle point of the objective, will be determined by the lines drawn from this middle point to A and B, and measured by $\frac{AB}{F_2}$. The proportion of these two angles is the magnification—

$$n = \frac{F_1}{F_2}.$$

As through the telescope we only see, at once, that part of the outer circle whose image in the focal plane of the objective extends over A B, the expression—

$$\frac{360^\circ}{2\pi} \cdot \frac{AB}{F_1}$$

gives us directly the value of the field of view. But—

$$\frac{AB}{D} = \frac{F_2}{F_1 - F_2}$$

where D denotes the diameter of the objective, and $F_1 - F_2$ the distance between it and the point at which are eye and eye-piece. Thus we obtain the expression formerly given for the field of view:—

$$\frac{360'}{2\pi} \cdot \frac{D}{F_1 - F_2} \cdot \frac{F_2}{F_1}.$$

Finally, we may find the value of the field of view immediately, as follows:—Suppose, instead of the objective, a simple aperture, M M (Fig. 3). Then the eye, being at *o*, would perceive the portion of space which corresponds to the angle S *o* S, and the rays M *o* M *o* would come from the outermost visible objects, lying in the directions S *o* S *o*. In consequence of refraction in the objective the rays, M *o* M *o*, proceeding to the eyes, do not form a straight prolongation of the rays, S' M S' M, which meet, not in *o*, but further on, at *o'*, at the distance x from the objective. Consequently, the limits of visible space are determined by the angle M *o'* M. The side of the field of view will be equal to—

$$\frac{D}{x} \cdot \frac{360^\circ}{2\pi}.$$

The distance, x, is obtained by the formula for conjugate foci; as *o* and *o'* are conjugate foci, then—

$$\frac{1}{F_1 - F_2} - \frac{1}{x} = \frac{1}{F_1}.$$

Hence the field of view is, as before,—

$$\frac{360^\circ}{2\pi} \cdot \frac{D}{F_1 - F_2} \cdot \frac{F_2}{F_1}.$$

Prof. Lubimoff further shows how the same theory applies to the Keplerian telescope.

He next discusses some optical illusions, which permit of being explained by his theory of optical windows.

It is known that a convex lens magnifies objects placed behind it at a distance smaller than the focal distance. It has probably been observed by many that when, with distance of lens from object unchanged, we move away from the lens, the object seems to grow larger, especially if it is in the neighbourhood of the focus, and, *e.g.*, consists of a series of dark lines on a white ground, as lines in a book. Judging from first impressions, it is difficult to believe that this obvious increase of the object is an illusion, and that, in reality, the size of the image on the retina—or, in other words, the angle under which the object seen through the lens appears to us—is diminished when we move away. This is indeed the case, however; the magnification is only apparent. An experiment like the following is fitted to show this. Behind the lens, *a a* (Fig. 4), at a distance shorter than its focal, stands a pasteboard screen, *m n p q*, on which a number of parallel equidistant lines are drawn. Behind this screen is a second and larger one, M N P Q, placed at the distance at which, according to the theory, that portion of the smaller screen seen through the lens appears to be. It is further understood that the lines drawn on the larger screen stand as far apart as, apparently, do the lines of the first screen seen through the lens. In this case that part of the screen (*m n p q*) which is visible through the lens will have the same appearance as the directly seen borders of the screen, M N P Q; and if one of the lines seen through the lens coincides with one of the lines on the larger screen, all the other lines seen through the lens will also correspond with lines on the larger screen. Now it appears, from experiment, that on moving away from the lens this coincidence continues. At the same time we observe that the number of lines visible through the lens is diminished.

The cause of the apparent enlargement referred to (on withdrawing from the lens) lies in the fact that while in one position, perhaps, 14 lines are visible; if the eye is further removed, only 8, 5, &c., lines are visible in the same field of view. Without reckoning for the distance of the eye from the screen, the observer arbitrarily infers —from the different number of lines in the field of view— that their distance from each other is altered, this distance appearing greater where few lines are visible.

Fig. 3.

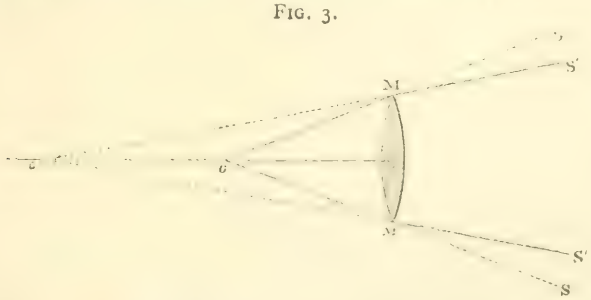
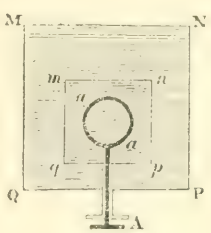


Fig. 4.



A curious observation may be made in the act of reading. When we look through an opening at the lines in a book, placed not far behind the opening, and when we move away from it, the letters appear at first (and so long as we can read) clearly diminished; when, however, light has become indistinct, and we can no longer read, the lines and their distance from each other appear to increase, just like the lines on the screen in the former case. So long as we are able to read distinctly, we pronounce judgment on the distance of the book and the size of the letters, according to the greater or less difficulty we have in reading; beyond this, however, we draw the same inference as in the case of the screen.

A. B. M.

CORRESPONDENCE.

ON BUTTER.

To the Editor of the Chemical News.

SIR,—The conclusion which I drew when I read through Dr. Campbell Brown's paper "On Butter," viz., that the author of it appeared "not to know that butter resembles suet, tallow, dripping, and lard, by containing, as they do, stearin, olein, and palmitin, and that it differs from them only by containing very small quantities of butyrin, &c.," has doubtless seemed rather harsh to some of your readers. Dr. Brown's letter, however, confirms my construction of his paper. As there seem to be persons who call for a detailed criticism in this instance, and who, with Mr. Catcheside, appear to require a more explicit statement, I will enter into particulars.

Touching *stearin*. This fat is well known to chemists to be of very frequent occurrence. In butter it was found by Chevreul long ago, and more recently by Heintz; and its existence in butter is generally admitted by chemists, as may be seen on looking into chemical text-books or into "Watts's Dictionary."

Now in Dr. Campbell Brown's paper (*vide* CHEMICAL NEWS, vol. xxviii., p. 1) butter is defined as follows:—"Chemically it consists of a mixture of neutral fats, the glycerides of the non-volatile acids, palmitinic acid ($C_{16}H_{32}O_2$), and butyroleic acid ($C_{12}H_{30}O_2$); and the glycerides of the volatile acids, butyric acid ($C_4H_8O_2$), capronic acid ($C_6H_{12}O_2$), caprylic acid ($C_8H_{16}O_2$), and caprinic acid ($C_{10}H_{20}O_2$).—(Wagner and Crookes). The last four glycerides are the characteristic fats of butter." Thus Dr. Brown enumerates six glycerides as constituents of butter, but omits to mention stearin, the glyceride of stearic acid. It will probably be suggested by charitable chemists that all which follows from this circumstance is that Dr. Brown forgot to put stearin on the list. A further examination of the paper led me to reject this hypothesis; and Dr. Brown's letter will, I think, be admitted—even by Mr. Catcheside—to have excluded any such explanation.

Dr. Brown now writes that "stearin can sometimes be obtained from butter and sometimes not; but it does not occur in butter as crystallised stearin."

I do not think I need make any further comment on this statement. Touching olein, this compound, which is the glyceride of oleic acid, is mentioned by Dr. Brown as existing in certain fats, such as beef suet, &c., but is not mentioned among the constituents of butter. Instead of it, the glyceride of what Dr. Brown calls butyroleic acid—an acid to which the formula ($C_{12}H_{30}O_2$) is assigned—takes its place. Some chemists may suggest that the name is an eccentricity, and the formula a misprint; but in his letter Dr. B. does not correct the formula.

With regard to palmitin, Dr. B. says in his paper that palmitin is one of the most characteristic ingredients of suet, &c., and leaves us in doubt whether or not he believes it to exist in butter; the glyceride which he attributes to butter being the glyceride of palmitinic acid (instead of palmitic acid). A tolerably correct knowledge of the constitution of butter is an indispensable preliminary to the detection of the adulterations of butter. With the hint that there is nothing improbable in the separation of impure stearin from butter placed under certain obvious physical conditions, I will therefore close my letter.—I am, &c.,

J. ALFRED WANKLYN.

London, July 19, 1873.

ON BUTTER.

To the Editor of the Chemical News.

SIR,—In estimating the water in butter, the presence of dripping can also be detected at the same time, by the peculiar odour of roast meat, and any one with a keen sense of smell can say whether beef or mutton dripping is the adulterant.

In the elaborate and interesting analysis of butter which Dr. Brown has given us, there is work enough for at least two days, particularly as a pure sample of butter has to be analysed along with it. May I ask, Is it necessary for every Public Analyst to make such a minute examination? Surely the presence of dripping, starch, or any foreign matter, is quite sufficient to produce a conviction, without being obliged to state the quantities; and the low fees which are paid for these analyses utterly preclude such elaborate examinations. For instance, Dr. Cameron has just been appointed Analyst to the County of Sligo, with the liberal salary of £25 a year, and weighted with this addition—that the charges for analysis are to range from 2s. 6d. to 10s.; and as Ireland is a great butter-producing country he will find his place no sinecure,—that is if he follows strictly the examination given by Dr. Brown.—I am, &c.,

J. CARTER BELL.

The Manchester Laboratory,
18, Exchange Street, July 21, 1873.

ON BUTTER.

To the Editor of the Chemical News.

SIR,—A little relaxation on Saturday last enabled me to become acquainted with the abstract of Dr. Campbell Brown's paper on the "Analysis of Butter" (CHEMICAL NEWS, vol. xxviii., p. 1), and the correspondence it has occasioned.

I have heard a good deal from the Doctor already about his method of analysing butter, in relation to a local inquiry. The published abstract is much more consecutive in details than the Doctor's replies to questions in the witness box. From the latter it would be inferred that he considers stearin and palmitin to exist in butter in a state analogous, if not identical, with that of *carbon* in sugar or paraffin; also that butter is physically constituted of an aggregation of globules in a manner similar to that of starch, German yeast, and such like bodies. This statement is repeated in the abstract of Dr. Brown's paper, section 3. It is such a novel assertion on the part of a scientific man, that I do not wonder Mr. Wanklyn's patience was a little ruffled by the study of it.

Respect for real or reputed scientific attainments, such as those accorded to Dr. Brown, determines me to give the statement that commercial butter, fresh or salt, is mainly composed of globular matter some consideration. I might, indeed, affirm a direct negative, as I did elsewhere, and so save time and space; but it may be well to add my reasons for the benefit of some readers who possibly may not be conversant with the subject.

Firstly, then, the matter of butter as it exists in fresh or new milk, presents the form of minute liquid globules. The microscope reveals that the globular form of the fat matter is due to the repulsive action of the aqueous menstruum and the liquid fat, and not to any enveloping tissue or coating which would conduce to the retention of the globules in their entity. When lactic acid is de-

veloped in the milk in sufficient quantity to overcome its natural alkaline condition and the milk is then churned, the diffused globules are made to adhere, and the result is a mass of solid butter of greater or less hardness, according to certain physiological conditions of the animal and its food. Now as the fat globules as observed in milk are devoid of cell walls, or envelopes, other than the aqueous medium in which they are diffused, it will be readily understood that when any number of them is made to adhere by the mechanical action of churning, the globular form presented in the milk will disappear, and other considerations being for the moment set aside, the resulting butter will present a homogeneous non-globular appearance under the microscope. Butter really does present this non-globular aspect when so examined.

Butter is not exceptional in this respect. All fatty substances, whether liquid or solid when educed as fats, from the bodies secreting them, animal or vegetable, are non-globular in their structure.

It is well to note the physical change impressed on the fat of milk by churning. Before this operation the globules in the milk are transparent and liquid; after, the fat is solid. Without going deeper into the consideration of the principle evolved in this change, I think it will be accepted as the result of the crystallisation of such constituents of the fat as are capable of assuming this state. Stearin and palmitin are such constituents. The crystals of the latter constituents are, however, so small in freshly churned butter as not to be defined by a ¼-inch power; but let the butter when churned be washed with tepid water of 75° to 80° F., or let it be exposed after washing to a summer heat and then cooled, the crystals then become so large as to be readily discerned even by lower powers than a ¼-inch objective. This fact is singularly confirmed in Dr. Brown's paper; and also the assertion that stearin and palmitin are not present as such in butter, as forcibly controverted. He states correctly that butter becomes opaque under 74° F.; above this heat a transparent fluid. Here the opacity is due to the separation of crystalline matter, and that matter stearin and palmitin, in varying proportions. If these constituents of butter existed in it as carbon exists in sugar or paraffin it would not be conceivable how the separation could so easily be effected. Dr. Brown, however, recently determined that certain butters submitted to him were adulterated, because he found crystallised matter in them; and corroborated his conclusion by the assertion that stearin, palmitin, and olein were not proximate components of butter. I use these names as synonyms of Dr. Brown's *glycerides*, and I dare say Mr. Wanklyn so comprehends them.

Regarding the estimation of water in butter, which varies from 8 to 20 per cent, a temperature of 212° in either water or air bath as prescribed by Dr. Brown, is inadequate. An approximate result may be obtained if the heating process were continued for a greatly disproportionate period, say a week, but not in the time devoted by analysts to such work.

Looking at Dr. Brown's paper as the exponent of his course of procedure, I may ask whether it is possible for him to execute the operations stated therein for the sum of 7s. 6d. and 5s. of current coin? for these it appears are the highest fees which he can charge in his official capacity.

Chemists appointed to carry out the provisions of the Adulteration Act, are introduced into a wide field of chemical study,—one which demands enlarged knowledge and experience to explore it, but from which much practical and valuable information can be obtained. Crude inconsiderate processes in the execution of the work will not add much lustre to the scientific standing of the analysts; and it may be well to show at the outset that conclusions founded on such crude or unreliable operations will not be accepted from them.—I am, &c.,

MARTIN MURPHY, F.C.S.

College of Chemistry, Liverpool,
July 21, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, June 30, 1873.

Reflections on a Memoir of La Grange, entitled "Essay on the Problem of Three Bodies."—M. Serret.

Extract from Memoir on the Analytical Theory of the Satellites of Jupiter.—M. Souillat.

Researches on the Reflection of Solar Heat at the Surface of Lake Leman.—M. Dufour.—The author experimented at five stations between Lausanne and Vevay, using three blackened bulbs containing thermometers. The first, suitably screened, gave the temperature of the air; the second, screened against direct solar radiation, received reflected heat; the third, unscreened, received both direct and reflected heat. The greatest proportion of reflected heat was 0·68 of the incident heat, and this was obtained with solar heights of 4° 38′ and 3° 34′. About 7°, the proportion was 0·4 or 0·5; about 16°, it was 0·2 or 0·3; while, if the sun was higher than 30°, the reflection was hardly appreciable. The author, however, failed to establish a law between the proportion of reflected heat and height of the sun. At stations some distance from the lake the proportion of heat reflected did not seem to increase with greater nearness of the sun to the horizon; the absorption by air probably compensating the increase which would otherwise appear. Most heat is reflected when the lake is calm. While a *greater proportion* of heat is reflected as the sun nears the horizon, the intensity of the direct ray diminishes, so that we come to a maximum of *actual quantity* of heat reflected. This maximum varies with the state of the surface and the diathermancy of the air. The total heat reflected, from the time at which reflection became sensible till sunset, was, at one station, in September, about equal to the heat radiated directly by the sun during the last three quarters of an hour before setting; at another station, in October, equal to that radiated directly in the last half-hour, &c. (various such comparisons were made). It was also approximately ascertained what absolute quantity was reflected by the lake in a square metre of a surface normal to the ray; this was, at four several stations, 104, 84, 112, and 134 calories respectively, in September and October. The foregoing results doubtless apply also to the sea, and have an important bearing on climate, vegetation, &c.

New Observations Proving the Presence of Magnesium in the Entire Border of the Sun.—M. Tacchini.—These observations were made on the 21st to the 23rd of May last. The author states it is clearly proved that there is greater activity in the northern hemisphere of the sun than in the southern, and that the general presence of magnesium corresponds to a minimum in the number of protuberances.

Note on Magnetism.—M. Gaugain.—The author indicates the mode in which he obtains the curves of demagnetisation, where an armature of soft iron is applied to the polar faces of a horse-shoe magnet, and withdrawn. It depends on the currents of induction produced in a wire. He thinks the idea of a condensation of magnetism near the surface of contact an erroneous one; for, when the armature is applied as stated, the magnetisation caused by currents of induction increases throughout the

extent of the horse-shoe, to the heel, or middle of the curve. Some other observations, with armatures of various shape and size, confirmed this. Again, when a soft iron bar is applied perpendicularly to the (length) surface of a horse-shoe magnet, the magnetic intensity appears to diminish about the bar, and it is commonly said that the magnetism, attracted by the soft iron, is condensed at the surface of contact. The author questions this; for if, before applying the bar, the curve of demagnetisation of the branches of the horse-shoe be determined, and then the changes this curve undergoes after application, it is found that the curve is divided in two; the part between the bar and the extremity of the branch falls, and that between the bar and the middle of the curve rises, *i.e.*, the magnetisation diminishes on one side and increases on the other. How, then, will the condensation of magnetism explain the increase in the one region? It is easy to understand, on the other hand, how the opposite modifications of the curve of demagnetisation result in a diminution of magnetic intensity; which intensity depends on the inclination of this curve, and this diminishes, at the same time, for both parts of the curve. The author further compares his method of determining the intensities at different points of a magnetised bar with the method of oscillations adopted by Coulomb. The curves agree, except near the extremity of the bar, where, therefore, a simple relation M. Gaugain had established between the magnetic intensity and that of the solenoidal current no longer exists.

Cooling and Freezing of Alcoholic Liquids and Wines.—M. Melsens.

Calculation of the Moments of Inertia of Molecules. M. Hinrichs.

Note on the State of Sericiculture in 1873.—M. Guerin-Meneville.

Comparison of the Indices of Refraction in Certain Isomeric Compound Ethers.—I. Pierre and E. Puchot.—The authors conclude that the numerical magnitude of the Index of Refraction, at least in the compound ethers, depends more on the chemical equivalent of the body than on its specific gravity.

Decomposition of Metallic Carbonates by Heat.—M. L. Joulin.—The carbonate of manganese was appreciably decomposed at 70°. Up to 200° this decomposition presents the characters of the phenomenon which Deville has named *dissociation*, *i. e.*, at a given temperature the tension of the carbonic acid, after a longer or shorter time, attains a value which remains constant, and that during the time of cooling the tension gradually returns to its primitive value, in consequence of the recombination of the carbonic acid and of the protoxide of manganese. From 250° to 300° the elastic force of the carbonic acid constantly increases up to two atmospheres. The body, which up to 200° had remained whitish, grows brown, the protoxide of manganese decomposing part of the carbonic acid, in order to convert itself into sesquioxide. Prolonged heating seems to render the carbonates more stable.

Production of Glycerin from Propylen.—C. Friedel and R. D. Silva.—The authors furnish confirmations of their former experiments and conclusions (*Comptes Rendus*, vol. lxxiii., p. 1379) to meet certain objections urged by Berthelot.

On a Glycerin of the Aromatic Series.—M. E. Grimaux.—The author endeavoured to obtain $C_9H_{12}O_3$; in other words, a molecule of glycerin in which an atom of hydrogen is replaced by the phenylic group, C_6H_5.

Determination of Sugars by Barreswill's Method.—M. Loiseau.—Feltz has shown that when the cupro-tartaric liquid is alkaline, the soda reacts upon crystallisable sugar. The author had previously recommended various chemists to dilute with water the cupro-potassic liquids used for determining the small quantities of non-crystalline sugar which occur in the produce of the Paris refineries. The author has since proved the existence of another source of error which soda may cause in the determination of glucose by Barreswill's method. This is due to the fact that soda promotes the restoration of a blue colour in the cupro-potassic liquid which has been decolourised under the influence of a sufficient quantity of non-crystalline sugar. Thus an excess of soda gives results below the truth. The test-liquor employed was prepared according to the formula of Fehling. It is needful to ascertain what proportion of soda should be present in the test-solution. This proportion can neither be increased nor lessened at random, since, if an excess of soda favours the re-colouration of the liquors, a too feeble alkalinity protracts too much the decolouration of the liquid. It appears that Barreswill's method employed for the determination of glucose may yield different results, according to the manner in which it is used. The alkalinity of the liquid should be such that a litre may be neutralised by 240 c.c. of decinormal sulphuric acid. With this precaution the method gives results accurate enough for all commercial purposes. It may even be applied to the determination of raw sugars, and may furnish results as accurate as those given by polarimetric assays. On a future occasion the author will give what he considers the best formula for the test-solution, and explain why it should be protected from the carbonic acid of the atmosphere.

Erythrophenic Acid, a New Reaction of Phenol and Anilin.—E. Jacquemin.—We have given a summary of this paper elsewhere.

On Crystalline Protiodide of Mercury.—P. Yvon.—This compound is best obtained by heating mercury and iodine in equivalent proportions, in sealed flasks, upon the sand-bath. The temperature must not be allowed to exceed 250°. The upper portion of the flask will be found lined with crystals of a fine red, which become yellow on cooling. On re-heating, the red colour begins to return at 70°, and at 220° a splendid garnet shade is attained. This is exactly the inverse of the phenomena presented, under similar circumstances, by the biniodide. The crystals of protiodide melt at 290° to a black liquid, which boils at 310°. If more rapidly heated it is decomposed, yielding mercury and a light yellow sublimate, which is not, as might be expected, a compound richer in iodine, but an oxy-iodide which may be represented by the formula $Hg_{13}O_6I_7 = 6HgO,7HgI$. This oxy-iodide is at first bright yellow and crystalline, but, especially if exposed to the light, it soon becomes first orange and then brick red, and falls to a powder.

Bulletin de la Societe Chimique de Paris, tome xx., No. 2, July 20, 1873.

Determination of Ferric Oxide by Means of Hyposulphite of Soda.—J. M. Crafts.—The most convenient solvent for ferric oxide in iron ores is commonly concentrated hydrochloric acid, but such solutions are not well adapted for titration with permanganate of potash. They are, however, perfectly adapted for volumetric determination with hyposulphite of soda. This method, performed as has been hitherto recommended, is not as exact as could be desired. The author has endeavoured to eliminate the causes of error in this procedure, which is recommended by its rapidity of execution and by the stability and easy preparation of the reagents employed. The only cause of error lies in the decomposing action which the free acid of the ferric solution exerts upon the hyposulphite of soda, and care must be taken to diminish this excess of acid to the point where its disturbing action becomes inappreciable. The following procedure renders it possible to obtain results as exact as can be expected from a volumetric method. The following solutions are needed:—*Hyposulphite of Soda.*—The commercial salt, purified, should be well dried at common temperatures. It is exposed for several days in

thin layers between folds of blotting-paper, and is pulverised afresh every day to expose to the air fresh surfaces. It is only after the lapse of several days that a product is obtained sufficiently dry and well powdered. The salt, thus prepared, no longer loses weight in dry air, and after its value has been determined, a normal solution may always be obtained by dissolving in water the weight indicated by experiment. If the salt is pure, the amount necessary to dissolve in water to obtain a viginti-normal solution is 12·4 grms. Such a solution keeps its value for a month, within 0·2 or 0·3 per cent. The solution of perchloride of iron which serves as standard for these experiments is made by dissolving pure iron, whose percentage of carbon is known, in strong hydrochloric acid. A few drops of nitric acid are added; the mixture is boiled for a few minutes, and then evaporated, till the crust of ferric chloride which forms begins to re-dissolve with difficulty in the acid solution. During the ten minutes which the latter part of the evaporation requires, it is necessary to watch attentively, so as not to pass the proper point. To make a viginti-normal solution of iron, it is necessary to dissolve in a litre of water 2·8098 grms. of fine iron wire, containing 99·65 per cent. of metallic iron. It is of importance that solutions more concentrated than viginti-normal should not be used. The analysis may be made by adding the hyposulphite in known excess, and titrating back with iodine to ascertain the surplus of hyposulphite. As nearly as possible, the same excess of hyposulphite should be used on each occasion. The reduction is completed in five or six minutes, and its termination is ascertained by adding a little sulphocyanide of potassium, which should not give a red colouration. The well-known reaction between iodine and starch, which indicates when a sufficiency of iodine has been added, is not appreciably diminished in sensibility by the volume of the liquid. In practice, an iron ore is boiled in hydrochloric acid in order completely to dissolve the ferric oxide, and the solution is evaporated down to the point indicated above. If the protoxide in an ore is also to be determined, the evaporation must be preceded by oxidation. It is convenient to take for each analysis 1·4 gr. dissolved in half-a-litre. A preliminary titration serves to determine approximately the quantity of hyposulphite equivalent to 100 c.c. of the ferric solution, and in the final operation 20 per cent more hyposulphite is taken. Water which is added during the analysis must be deprived of atmospheric oxygen by boiling. Ferric chloride reduced to the ferrous state during an analysis of the procedure indicated may be exposed to the air for twenty-four hours without becoming sensibly oxidised.

Heat Liberated in the Reaction between Water, Ammonia, and the Alkaline Earths, Lime, Baryta, and Strontia; Constitution of Alkaline Solutions.—M. Berthelot.—A lengthy thermo-chemical paper.

On Certain Ammoniacal Salts of Silver.—M. O. Widman.—The salts in question have been obtained by dissolving the salts of silver in an excess of ammonia, and crystallising over a mixture of quick-lime and sal-ammoniac. The original silver salts were obtained by precipitating nitrate of silver with alkaline tungstates, molybdates, and arseniates.

On Certain Compounds of Zirconium.—S. R. Paijkull.—The compounds examined are the chloride, phospho-chloride, tetrachloride, sulphide, oxychloride, hydrate, sulphate, arseniate, and orthophosphate.

Action of Chloride of Benzyl upon Naphthylamin.—Ch. Froté and D. Tommasi.

Erythrophenic Acid, a New Reaction of Phenol and Aniline.—E. Jacquemin.—When phenol is treated with chlorine-water, no reaction is observed, and ammonia added to the mixture subsequently develops no colouration. It is known that aniline, on the contrary, suspended in water, with the addition of a solution of chlorine, takes a rose colour, which rapidly becomes purple, violet, and, lastly, brownish red, and that ammonia added at this last juncture increases the brownness. It is no longer the same when a mixture of a drop of phenol and a drop of aniline is submitted to the action of solution of chlorine. A permanent rose-red is obtained, which may be turned to a blue either by ammonia or by the alkalies or alkaline carbonates. Acids restore the original redness. The author concludes that there exists a phenate of phenylamin; that the new body produced in the above reaction is a red acid, forming blue salts; the erythrophenate of soda may be produced by causing hypochlorite of soda to act upon the mixture of phenol and aniline. The blue thus formed is remarkable for its purity and extraordinary tinctorial power. If two drops of the mixture of phenol and aniline be added to 2 litres of water, and then treated with hypochlorite, the blue in an hour or two becomes so intense that it could be recognised even in 4 litres of water. This reaction may be useful in toxicological researches either for aniline or phenol. The purity and permanence of the blue might render it fit for the uses of the dyer, but it will not bear steaming. The extreme facility with which it is reddened by the feeblest acids is likewise an objection. In this respect it far exceeds litmus.

Transformation of Succinic Acid into Maleic Acid.—E. Bourgoin.

Ethylacetylen Formed Synthetically, and on its Identity with Crotonylen.—L. Prunier.—The identity of those two substances has been established by a comparison of their tetrabromides.

New Method of Producing Chlorine.—F. de Lalande and M. Prud'homme.—Lamy, in examining the action of a mixture of hydrochloric acid and of air upon silicates or mixtures of silica and chlorides, which the authors had previously studied, seems to ascribe the evolution to the presence of oxide of iron in the substances brought in contact. It must be observed that the reaction may be thus expressed: oxygen displaces chlorine from chlorides at a red heat, and in presence of an acid capable of uniting with the base thus formed. A mixture of hydrochloric acid and of air may thus give rise to a continuous evolution of chlorine. The authors have experimented in glazed earthen tubes upon 10 grms. of fused chloride of sodium and 10 grms. of fused boracic acid placed either separately or together in a porcelain boat, and have found:—That chloride of sodium and boracic acid taken singly give at redness, in a current of dry air, mere traces of chlorine. In the same conditions a mixture of the two enabled us to collect 15 per cent of the chlorine present in the chloride of sodium. The displacement of chlorine by oxygen has been obtained in presence of the silicic, boracic, phosphoric, and stannic acids, and of alumina. The influence of the oxide of iron or other impurities is insignificant.

Composition of Bone Phosphate.—C. Aeby (*Journal f. Praktische Chemie*, vol. vi., p. 169, 1872).—For each equivalent of tricalcic phosphate the author finds half an equivalent of crystallised water; one-third of basic water, not expelled below 450°; one-third equivalent of lime in excess; and one-sixth equivalent of carbonic acid. The composition of bone earth is therefore highly complex.

Chemical and Crystallographic Notes on Certain Salts of Glucinum and the Cerite Metals.—C. Marignac (*Archives des Sciences de la Bibliotheque Universelle*, March, 1873).—The author examines the fluoride of glucinum and potassium; fluoride of glucinum and sodium; fluoride of glucinum and ammonium; sulphate of cerium; nitrate of lanthanum; nitrate of didymium; nitrate of cerium; ammoniaco-nitrate of lanthanum; ammoniaco-nitrate of didymium, and the chloro-platinates of the group. The author concludes the atomic weight of lanthanum to be 92·5.

Analysis of a Fossil Human Bone.—M. Terreil.—In one portion the carbonate of lime was 64·33 per cent, whilst the phosphate amounted merely to 17·12.

Influence of the Different Colours of the Spectrum upon the Decomposition of Carbonic Acid of Plants.—W. Pfeffer (*Pog. Ann.*, vol. cxlviii., p. 86, 1873, No. 1).—Taking the amount decomposed under the yellow ray at 100, the following scale was obtained:—

Red	25·4
Orange	63·0
Yellow	100·0
Green	37·2
Blue	22·1
Indigo	13·5
Violet	7·1

Reimann's Färber Zeitung, No. 26, 1873.

Dialysed Iron.—For mordanting silk, &c., iron can be applied in the state of dialysed oxide. To prepare this compound, a solution of iron oxide in hydrochloric acid is introduced into the dialyser. After some time, the hydrochloric acid will be found to have escaped into the surrounding water, whilst the oxide of iron remains in the dialyser in a soluble condition, free from any hurtful amount of acid. This solution is found remarkably well adapted for dyeing heavy blacks upon silks, which it mordants in perfection without "tendering" the fibre. It would seem as if every case of mordanting was a dialytic phenomenon, the fibre being in effect a conglomerate of membranes. The degree to which the iron solution is to be deprived of its acid is a matter to be determined by experience in such class of cases.

Practical Receipts.—The editor gives formulæ for dyeing old batist articles a red-brown; for dyeing cotton-warp rags a rose-colour, and for producing yellow lists on woollen piece-goods dyed with Brazil-, log-, sanders-, and calliatur-woods; for a discharge with fuming nitric acid; for dyeing scarlet on flannel or woollen-yarn—in which there appears nothing novel; and for dyeing cotton-wool a black.

Anthracen Blue, an Alleged New Colour.—According to its reactions this is an ordinary aniline blue. Anthracen can produce tinctorial acids, such as alizarin, but not substantive basic colours.

New Iron Mordant.—Dissolve 200 grms. chromate of potash, 200 grms. oxalic acid, and 6 kilos. green vitriol, in 6 litres of water.

Revue Scientifique de la France et de l'Etranger, July 19, 1873.

This number contains no chemical matter.

Archives Neerlandaises, Tome vii., Livrais 4, 5.

On Nonylic Acid.—P. N. Franchimont and Th. Zincke.

On Normal Heptylic Acid.—P. N. Franchimont.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in and connected with the manufacture of electrotypes. James Noad, engineer, Hackney Wick, Middlesex. December 18, 1872.—No. 3839. A new material is used for forming the moulds, consisting of lead melted and mixed with roll-sulphur, ground fine, then mixed with gutta-percha or its equivalent. To copy type, this material is milled, brushed over with black-lead, then softened, and pressed on the type; afterwards it is put into a lead bath, and worked by a battery, then washed, and put in a copper bath, and backed. To surface, the mould is put into a sulphate of copper bath containing 7 per cent free acid, the bath is worked with a large anode, and rubbed during deposition,

Improvements in the estimation of metals. Joseph Norman Lockyer, F.R.S., Fitchley Road, Middlesex. December 18, 1872.—No. 3846. My invention consists in the application of the spectroscope to the estimation of metals.

Improvements in treating human excreta, and in apparatus for working the excreta and converting the same into a dry and highly concentrated manure. William White Fereday, civil engineer, 5, Falmouth Road, Dover Road, Surrey. December 21, 1872.—No. 3882. This Provisional Specification describes a system of collecting night-soil, and converting it into manure in such manner that no effluvia is emitted or ammonia lost.

Improvements in the manufacture of asphalte for paving and covering roads and ways, and in the apparatus employed therein. Alexander Prince, 4, Trafalgar Square, Charing Cross. (A communication from Peter Barthel, Ferdinand Capitaine, and Philipp Holzmann, all of Frankfort-on-the-Maine). December 21, 1872.—No. 3886. The novelty of the invention consists in dissolving natural asphalte in sulfurete of carbon or in benzine, by the application of heat, the solution of which, when passed through a sieve, is placed in a kettle heated by steam and a furnace, in order that the sulferete of carbon or benzine held in solution may be evaporated, after which the asphalte is mixed with granular calcareous spar or marble, preparatory to its being used for the purpose desired.

An improved stopper for bottles. Alphonse Krieger and Augustin Cauderlier, Boro', Surrey. December 21, 1872.—No. 3887. The stopper consists of a short tube of india-rubber, one end being closed and of bulbous form, to press against the inside of the neck of the bottle and make a tight closure. A head is provided to prevent the stopper being pushed too far into the bottle, and for handling the same.

An improvement in the process of unhairing and preparing skins or hides to be employed for making or dressing into leather of any kind. Joshua Senior, foreman skinner, New Ross, Wexford, Ireland. December 23, 1872.—No. 3889. Hitherto lime has been used for this purpose, but in carrying out my invention I make use of soda-ash or any other alkaline solution in combination with lime. To 18 gallons of boiling water I add about 20 lbs. of soda-ash, which must be stirred till the alkali is completely dissolved; then, immediately afterwards, about 1 cwt. of fresh quick-lime must be thrown in gradually. It will then begin to boil fiercely, so that the pit-tank or any other suitable vessel should be sufficiently large to prevent it from boiling over. If, when done boiling, the solution is not all absorbed, a little more fresh lime may be added; when the mixture is quite cold it is ready for use, and should be of the consistency of soft clay. To each pit capable of containing or working fifty or sixty dozen of sheep pelts, from about 1 cwt. 2 qrs. to about 2 cwts. of the mixture, with a sufficient quantity of water, may be put in when making new.

Improvements in closets and apparatus for collecting and disinfecting fœcal matters and converting the same into manure or human guano. Leos Antoine Badin, civil engineer, New Ormond Street, Middlesex. December 24, 1872.—No. 3913. The first part of this invention relates to improvements in the arrangement and construction of water-closets for the purpose of preventing the water (used for washing the pan) from mixing with the urine and fœcal or solid matters. The second part of this invention relates to improved apparatus for receiving, treating, and filtering the urine and fœcal matters as they are discharging from the water-closet or other source. Thirdly, in the application of a new chemical solution for the direct chemical treatment of urine in order to extract the salts (ammoniacal) which may be mixed with the solid matters, in order to increase the agricultural value of the manures thus obtained. Fourthly, in improved arrangement and chemical disposition of apparatus for the purpose of applying this improved system to urinals in order to treat the urine chemically. Fifthly, in improved means of preserving the manure when dried and pulverised, together with improved chemical combinations for fixing the fertilising principles which the organic matters contain, in order to avoid their destruction, which generally follows by decomposition (caused by fermentation).

NOTES AND QUERIES.

Crome-Yellow.—(Reply to "Colour.")—The yellow colour you refer to is tungstic acid made from tungstate of soda.—A. Keiffenheim and Co., 27, Side, Newcastle-upon-Tyne.

TO CORRESPONDENTS.

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G. A.—We shall be happy to insert your letter if you conform to our rules and send us your address.

BOOKS RECEIVED.

The Trustees' Guide (Cracroft's Investment Tracts). London Edward Stanford.

SUPPLEMENT
TO
THE CHEMICAL NEWS.
VOL. XXVII. No. 713.

INVESTIGATION OF THE FLUORESCENT AND ABSORPTION SPECTRA OF THE URANIUM SALTS.*

By HENRY MORTON, Ph.D.,
and H. CARRINGTON BOLTON, Ph.D.

AMONG bodies possessing a property which he named "internal dispersion," Sir David Brewster, in 1848, mentioned a glass of a greenish yellow colour. In his admirable treatise "On Fluorescence," published in the *Phil. Trans.* for 1852, Stokes describes the examination which he made of the light emitted from the glass, which he found to yield a discontinuous spectrum, and relates how, finding that the colouring material of this glass was the oxide of uranium, he proceeded to study other compounds of the same base.

The following is a list of the bodies thus examined :—

1. Nitrate of uranium, crystals and solution.
2. Yellow uranite (lime uranite).
3. Green uranite, or chalcolite (copper uranite).
4. Pitch blende.
5. Hydrate of peroxide of uranium, U_2O_3+2HO.
6. Acetate " "
7. Oxalate " "
8. Phosphate " "
9. Uranate of potassa.
10. " lime.
11. Solutions by means of alkaline carbonates.

This paper of Stokes was the first thorough discussion of the subject, and at once established the true character of fluorescent actions, which, though before observed in a few instances, were in no wise understood. The investigation is, indeed, a masterpiece in its originality, ingenuity, and thoroughness; but in science no work can ever be exhaustive, and thus even such a research as this leaves ground yet to be explored. The spectroscope, as an instrument of precision, had not, in fact, at this time been thought of, while the general character of the spectra formed by the fluorescent light emitted by many of the above list of substances was discussed, as also the bands of absorption shown by some of them with transmitted light; no attempt was made to measure the exact location of bands, and to record accurately their relative positions in different compounds, and other matters of detail requiring precise measurements. It is, however, wonderful, notwithstanding this, how far progress was pushed even with the less perfect appliances then at command; and we shall have frequent occasion to refer to Professor Stokes's prior indications of actions which more refined instrumental appliances have enabled us fully to develop.

In 1859 Becquerel published in the *Ann. de Chim. et de Phys.*, 3rd series, vol. lvii., p. 101,† an account of observations made with his phosphoroscope, and other methods involving the use of a spectroscope, upon many bodies, including the following uranium salts :—

1. Nitrate of uranium.
2. Uranium glass, *i.e.*, canary glass.
3. Double fluoride of uranium and potassium.
4. Perchloride of uranium, *i.e.*, oxychloride of uranium.
5. Uranite.
6. Double sulphate of uranium and potassium.

Two drawings are given to indicate the position of the bright bands with reference to the Fraünhofer lines, the first representing the spectra of canary glass and uranic nitrate, the other those of potassio-uranic oxyfluoride, urunic chloride, and the mineral uranite.

The existence of absorption-bands in crystals of uranium nitrate is also noticed, but no measurements or exact description is given. Indeed this work, which deals chiefly with phosphorescence, devotes but a small space to the subject we are now considering.

Various other brief discussions, such as that of Werther in the *Journ. fur Prakt. Chem.*, vol. lxv., p. 349,* in which the simple fact of fluorescence and the general colour of the emitted light is noticed in some salts of uranium and other bodies, appeared subsequently, but no other work of importance or extent was undertaken for some time after that of Stokes and Becquerel in reference to the uranium salts in their fluorescent relations.

This was about the condition of the subject when, in the spring of 1872, we undertook the accurate measurement and plotting of the fluorescent spectra of the uranium salts, preparing all the salts used ourselves so as to be confident of their purity.

A large number (over thirty) had been so studied, the results classified and discussed, and a memoir partly written, when, in the *Comptes Rendus*, August 5, 1872, we found the abstract, published by Becquerel, of a research covering very much the same ground. In the December number of the *Ann. de Chem. et de Phys.* for the same year appeared the entire memoir, in which were given the observations and measurements made upon eighteen salts.

Many of his conclusions were, however, different from those at which we had arrived, and we therefore determined to withhold our publication until these points of variance could be thoroughly re-examined. Such examination has confirmed our original results, and we therefore now publish our work as an independent research, which, of course, lays no claim to any of the results already obtained by Becquerel, but which will be of value as a combination of these, and will add to the knowledge of the subject in many directions, in which what we have done has been nowhere anticipated.

We should also state that Hagenbach, in his admirable series of papers on fluorescence, has given measurements of the spectra of canary-glass and uranic nitrate, *Pogg. Ann.*, vol. cxlvi., p. 393.

Methods Employed.

Our methods of examination do not differ from those employed by Stokes and Becquerel except in small details by which the labour of observation was facilitated, and by the means at our disposal for securing accuracy in the measurements. They have already been described by one of us, in connection with a similar investigation in which they were employed,† but to avoid trouble of reference, we will here briefly re-state them.

The general method pursued was as follows :—

Sunlight being reflected horizontally into a darkened room by a porte-lumiere was concentrated by a lens, and filtered of all rays below Fraünhofer's line F by a tank containing a strong solution of ammonio-cupric sulphate placed in front. Two tanks containing liquids of different concentration interchangeably used.

In the front of the lens was placed a little circular table carrying on its edge eight niches capable of supporting test-tubes or specimen bottles, and rotating with a "click," so that each of these could be readily brought into an identical position. The blue light falling on the specimen placed in one of these niches, the dispersed light was observed by means of a spectroscope. The instrument most used in this work was a Browning single-prism spectroscope, though one (by the same maker) with two prisms, and also a chemical spectroscope of Deraga, were also employed in special cases. A direct-vision hand

* Communicated by Professor Morton.
† See also "La Lumiere," vol. i., p. 378.

* See also *Phil. Mag.*, 1855, vol. x., p. 390.
† "The Fluorescent Relations of Certain Hydrocarbons found in Petroleum Distillates," by Henry Morton, CHEMICAL NEWS, vol. xxvi., p. 272.

spectroscope was also found very useful for preliminary observations and for recognition of faint absorption-bands.

For the study of the absorption spectra, the various pieces of apparatus were re-arranged so as to observe transmitted light, the rotating stand being replaced by a block or table, on which the objects were successively placed.

To observe solid substances in this way, various devices were employed. If a crystal of the requisite dimensions could be obtained, it was cemented to a plate of glass or mica, and supported vertically by means of a flat cork, in which the edge of the plate was sunken. Powders, such as the uranic oxalate, phosphate, &c., were mixed with a little water, and allowed to dry in a thin film on plates of glass or mica. In other cases, as with the double uranic sulphates, the salt was placed on a slip of glass and moistened with a very little water. Another similar glass was then placed upon it, and pressed down with a gentle rotary or grinding motion, by which the substance was reduced to small fragments in close proximity, which formed a film whose thickness could be graduated with ease. Gummed labels pasted over the ends of the slips kept all in place.

Solutions were examined either in bottles of white glass of about 1 oz. capacity (being 1 inch in diameter), or in small specimen bottles made from glass tubes whose diameter was only about ½ an inch.

Other special arrangements, which were from time to time employed in particular cases, will be described in connection with the substances to whose examination they were adapted.

We hereto append a list of the substances which we have prepared, and whose spectra, both of fluorescence and absorption, we have carefully measured and mapped.

Uranium Compounds Observed.

Acetates—
Uranic acetate bi-hydrate.
" " (anhydrous).
Ammonio-uranic acetate.
Bario- " "
Calcio- " "
Cadmio- " "
Cobalto- " "
Plumbo- " "
Lithio- " "
Magnesio- " "
Mangano- " "
Nickelo- " "
Potassio- " "
Silver- " "
Sodio- " "
Strontio- " "
Thallio- " "
Rubidio- " "
Zinco- " "

Arseniates—
Mono-uranic arseniate.
Di- " "
Sodio- " "
Cupro- " "

Borate—
Sodio-uranic borate.

Citrate—
Ammonio-uranic carbonate.
Potassio- " "
Sodio- " "

Chlorides—
Uranic chloride (acid).
" " (neutral).
Ammonio-uranic chloride.
Potassio- " "

Fluorides—
Uranic oxyfluoride.
Ammonio-uranic oxyfluorid.
Bario- " "
Potassio- " "
Sodio-uranic oxyfluoride.
Uranous fluoride.
Sodio-uranous fluoride.
Potassio- " "

Formiate—
Uranic formiate.

Nitrate—
Uranic nitrate.

Oxalates—
Uranic oxalate.
Potassio-uranic oxalate.

Oxides—
Uranic oxide (anhydrous).
" " (hydrated).
Three-fourth oxide (uncrys.)
" " (crys.)

Phosphates—
Mono-uranic phosphate.
Di- " "
Hydrated di-uranic "
Uranic pyro- "
Ammonio-uranic "
Calcio- " "
Cupro- " "

Sulphates—
Uranic sulphate tri-hydrate.
Do. (mono-hydrated).
Ammonio-uranic sulphate bi-hydrate.
Do. (anhydrous).
Ammonio-di-uranic sulphate (anhydrous).
Lithio-uranic sulphate.
Magnesio-di-uranic sulphate hepta-hydrate.
Magnesio-uranic sulphate tetra-hydrate.
Do. (anhydrous).
Potassio-uranic sulphate bi-hydrate.
Do. (anhydrous).
Rubidio-uranic sulphate bi-hydrate.
Do. (anhydrous).
Sodio-uranic sulphate penta-hydrate.
Do. mono-hydrate.
Do. (anhydrous).
Thallio-uranic sulphate tri-hydrate.
Do. (anhydrous).
Uranous sulphate.

Uranates—
Ammonium uranate.
Barium "
Sodium "
Plumbic "
Potassium "
Thallium "
Tetrethylium "

In Fig. 1. we have given drawings of some of the most characteristic spectra of fluorescence and absorption. In these drawings the refrangibility of the light is indicated on the scale with millimetre divisions introduced for this purpose by Bunsen. This scale was selected for the double reason, that it corresponds very nearly with the appearance of the spectrum as seen in the spectroscope employed, which is one largely in use and peculiarly well adapted to such observations as the present, and that it is largely used in all chemico-spectroscopic work, and would therefore be most familiar to those likely to take interest in this work, which has a decided chemical affiliation.

The relative intensities of various parts of the bands, and of the bands of each spectrum among themselves, is indicated by the depths of the white spaces, the distinction between the bright bands of fluorescence, and dark bands of absorption, being marked by making the first white and the other shaded. No attempt is made to indicate the relative brightness of different spectra.

This woodcut is to be regarded, however, rather as an illustration than as a map in which various positions are to be found with great precision. From the nature of the work, correction after proof is limited to very slight variations, and the full difficulty of accurate execution did not appear until the work was finished.

The spectra, as here shown, will be found correct in the character and arrangement of the bands in each, but small errors in the location of the maxima of bands must be expected, and, in fact, for all points where precision is required, it will be necessary to refer to the exact numerical expressions.

As will be seen further on, the behaviour of absorption-bands is a very useful assistance and guide to the study of certain changes in these salts, and we have therefore given some attention to these, although a variety of considerations indicate that no such connection exists between the band of absorption and fluorescence in these salts, as would be at first suggested by their general similarity of arrangement.

A single glance at the woodcut will exhibit the existence of very characteristic differences between the spectra of certain salts, and it will be evident that, in a number of cases, one body can be readily discriminated from another by this means. Indeed, in the course of this investigation, the fact of admixture in many of the commercial uranium salts was recognised in this way, without opening the bottles in which the materials in question were packed, and, in other cases, the progress and consummation of a change in composition, or in the formation of a compound, was watched and recognised with the greatest ease and precision.

In almost every case there is a tendency of the light to fade off in the bands towards one side more gradually than towards the other. In nearly all spectra this graduation is greatest towards the less refrangible end of the spectrum.

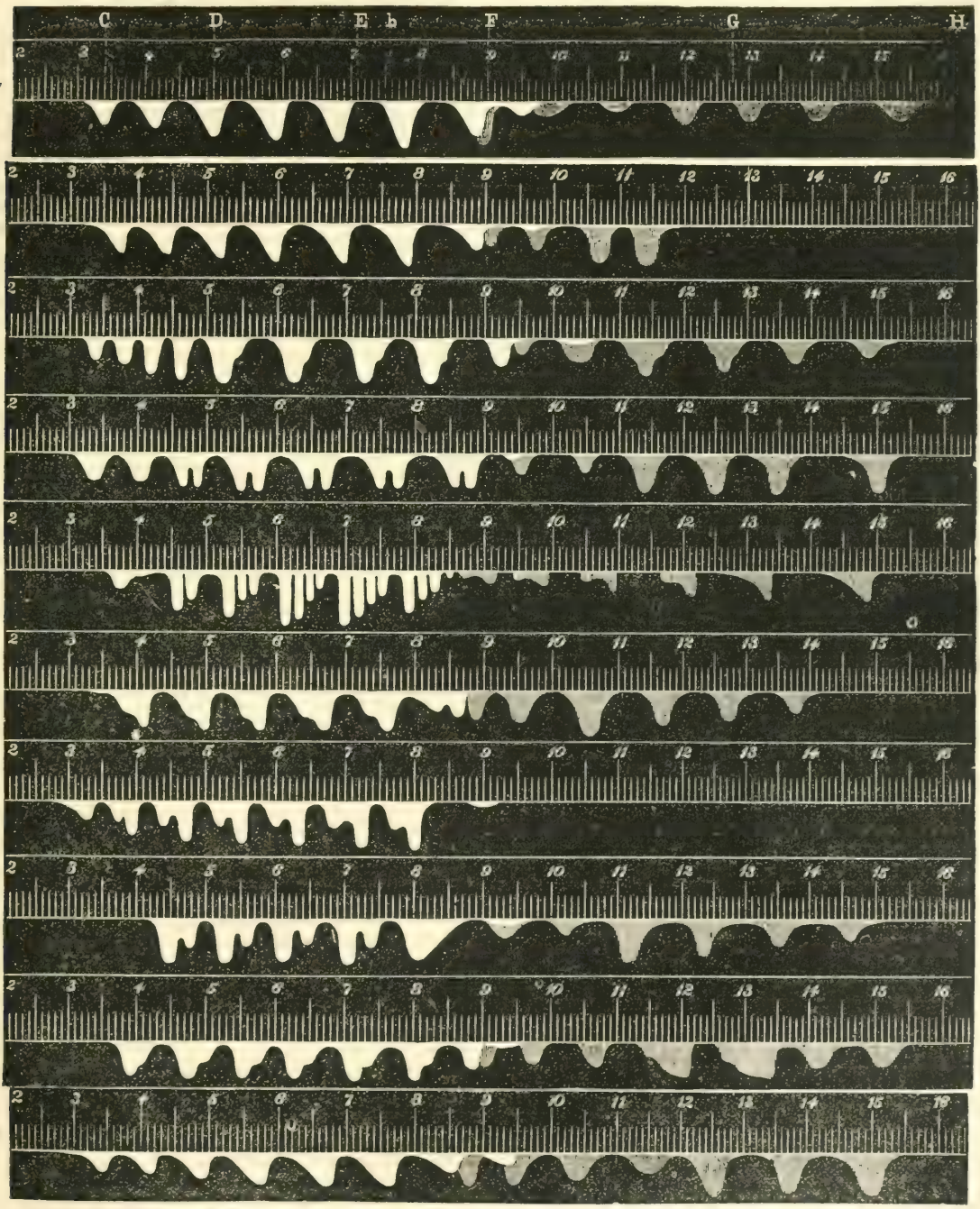
The character of any one band is, as a rule, a type of all the bands of a spectrum; but to this a remarkable exception is found in the double acetates of uranium generally, and especially in the sodium salt whose fluorescence is the brightest.

In the spectrum of this salt the first four bands at the lower end of the spectrum in the orange and red differ entirely in character and spacing from the rest, except the fifth, which seems to be in a transition state. This will be seen at once by a glance at spectrum 3 of the woodcut.

It is also true, as a rule, that double salts with the same acid have bands of a like character; but to this also there are decided exceptions, and it is by no means true that all salts with the same acid—as, for example, acetates and double acetates, as stated by Becquerel—have like bands. This chances to be true in the case of the sulphate and normal double sulphates, but in the case of the acetate and double acetates, fluoride and double fluorides, chloride and double chlorides, as also among the numerous hydrates of the sulphates, it fails to maintain itself.

A glance at spectra 4 and 5 on Fig. 1 will show that

FIG. 1.



1. Uranic nitrate. 2. Uranic acetate. 3. Sodio-uranic acetate. 4. Uranic oxychloride (acid), mixed hydrates. 5. Potassio-uranic oxychloride. 6. Uranic oxyfluoride. 7. Bario-uranic oxyfluoride. 8. Uranic phosphate, mixed hydrates. 9. Calcio-uranic phosphate. 10. Ammonio-uranic sulphate.

nothing could well be more unlike than the spectra of uranic oxychloride and the potassium chloride.

The question naturally arises, how far the spectra of substances are constant, and in what way a change in spectrum if observed is to be interpreted.

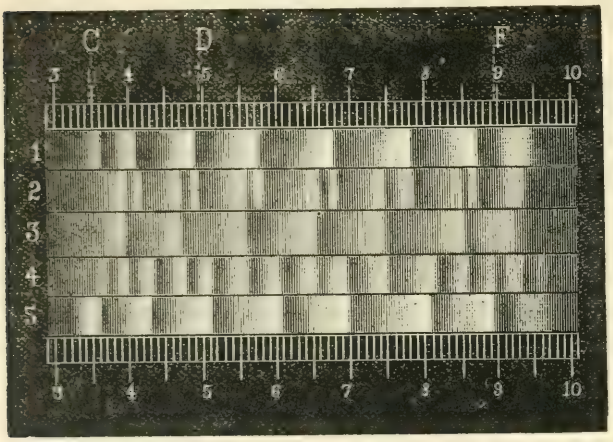
To this we would reply that we have so far found that no substance has its spectrum changed by anything which does not affect its composition, excluding the effect of heat, which in all cases temporarily modifies fluorescent action, and the destruction of crystalline structure by fusion, which in some cases has a like effect permanently. We must also exclude certain cases in which, by peculiar treatment, a substance has been caused to give a continuous spectrum, in place of what may be considered its normal one.

We may, therefore, confidently assert in many cases whether (under certain treatment) a body has or has not suffered a change in composition, and, indeed, trace such a change step by step.

This part of the subject can be best elucidated by a narration of our experience in the first case in which this principle was applied.

Stokes had noticed certain effects in nitrate of uranium which had been fused and partly dehydrated, and after an

FIG. 2.



attempt to reproduce his results, the ammonio-uranic sulphate was in turn treated in a like manner.

A little of the crystallised salt containing 2 atoms of water was placed in a short test-tube, and heated until part of its water had been expelled. On examination (after cooling, for while hot little fluorescence was manifested) its spectrum was found to be of a duplicate character, consisting of the bands belonging to the normal salt, and another set, each line of which was a little displaced downwards in the spectrum. On heating again and expelling more water, the intensity of the new spectrum was increased, and that of the old one diminished; and this continued until—when water ceased to come off—the new spectrum alone occupied the field. It was, therefore, concluded that this was the spectrum of the anhydrous salt.

On now pushing the heat further white fumes were expelled from the salt, and on examination—in addition to the spectrum just described—yet another new one was perceived, having its bands displaced *upwards* in a very marked manner. Further heating drove off more white fumes and strengthened this new spectrum, while it diminished the one proper to the anhydrous salt, until at last fumes were no longer expelled even at a temperature of about 650° F., and the last spectrum in turn occupied the field alone. It was then seen to be like the spectrum of the normal salt in character, but with its bands displaced upwards in a degree increasing from the less to the more refrangible extremities of the scale. The following table will give some notion of these spectra:—

Fluorescent Spectra of Ammonio-Uranic Sulphates.

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
Normal salt (hydrated) ..	36·0	41·6	49·2	58·1	68·0	77·0	86·0	95·0
Dried salt (anhydrous) ..	33·4	40·0	48·0	56·3	65·7	75·2	86·0	92·8
Heated salt.. ..	36·0	42·4	51·2	60·3	70·0	79·8	89·2	96·8

As also Figure 2, in which 1 is the normal salt, 2 the mixture of this and the anhydrate obtained by partial drying, 3 the pure anhydrate, 4 the mixture of this and the new salt obtained by partial ignition, and 5 the pure ammonio-di-uranic sulphate.

The white fumes expelled in the process of heating were ammonium sulphate, and the resulting compound yielding the new spectrum, therefore, might have been formed in one of two ways; either all the ammonium sulphate had been driven out, or a portion only. It became necessary, therefore, to test the heated salt for ammonia, which was done by distilling a portion with hydrate of calcium, and receiving the distillate in Nessler's reagent. The abundant precipitate obtained established the presence of ammonia in such quantity as to render the delicacy of the test applied quite superfluous.

The question then arose, Is this salt a definite compound of uranic sulphate with ammonium sulphate? Analysis alone could reply.

The heated salt possessed a somewhat stronger greenish hue than the normal salt; it was completely soluble in water with the exception of a few dark coloured grains, probably consisting of U_3O_4.

For analysis the salt was dissolved in water, and the sulphuric acid thrown down by barium chloride; after separating the excess of this reagent in the filtrate the uranic oxide was precipitated by ammonia, ignited and weighed as U_3O_4 in the usual manner:—

0·6444 grm. gave 0·5284 grm. $BaOSO_3$=28·15 per cent SO_3, and 0·4194 grm. U_3O_4=66·30 per cent U_2O_3. The formula, $2(U_2O_3SO_3)+NH_4OSO_3$, requires the following percentages:—

		Calculated.		Found.
$(U_2O_3)_2$	=	288	66·36	66·30
NH_4O	=	26	5·99	—
(SO_3)	=	120	27·65	28·15
		434		

From this it is evident that one-half the ammonium sulphate in the normal salt is driven out by heating, leaving an anhydrous ammonio-*di-uranic* sulphate.

In his recent memoir Becquerel describes, under the name of a sub-ammonio sulphate of uranium, a salt obtained in the preparation of nitrate of uranium from impure materials, and states that it is the only uranium compound whose fluorescent light yields a continuous spectrum. The composition given by him (Ur_2O_3 4 parts, SO_3 2 parts, ammonia 1 part), unless regarded as a mere rude approximation, would agree better with a mixture of several salts than with any probable formula of an ammonio-uranic sulphate. This may, however, be a case of what may be called the abnormal continuous spectrum already alluded to.

We have found uranium compounds yielding continuous spectra, but the true sub-ammonio sulphate—or, rather, ammonio-di-uranic sulphate—does not appear to belong to that class.

(To be continued.)

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ON THE

PRESENCE OF CYANOGEN IN BROMINE.

By T. L. PHIPSON, Ph.D., F.C.S., &c.

I HAVE lately discovered in bromine issued as pure for pharmaceutical use, a notable amount of cyanogen. It has been known for many years (and I have myself alluded to it in another place) that during the manufacture of iodine a certain quantity of that most beautiful, but dangerous, compound, iodide of cyanogen, sometimes finds its way into one of the glass condensers; and it would appear, from the experiments to which I now allude, that a similar compound with bromine may occur in this liquid element—a more serious case than the other, since it is dissolved and masked in the liquid.

The presence of cyanogen in bromine may be detected in the following manner:—Take an equal weight of iron-filings (say ½ oz.) to that of the bromine, and add to the iron-filings four or five times their weight of water; mix in the bromine very gradually, and stir all the time, filter rapidly while warm from the reaction, place the filtered liquid in a partially closed bottle, and in the course of some hours a deposit of ferricyanide of iron (Berlin blue) will have formed, and may be collected on a filter. In the course of two days (with the above quantity) the whole of the cyanogen is thus eliminated.

In the samples of bromine hitherto examined, I estimate there has been from 0·5 to 1 per cent of cyanogen in round numbers, and I am rather inclined to believe that this substance is often present in commercial bromine. If perfectly pure bromine be used, the same reaction would enable us to detect cyanogen in steel.

ON THE ESTIMATION OF MAGNESIUM AS PYROPHOSPHATE.

By WOLCOTT GIBBS, M.D.

ALL works on quantitative analysis recommend the precipitation of magnesium in the form of ammonio-magnesic phosphate, from cold solutions, by disodic phosphate. I find it more convenient, if not more accurate, to employ microcosmic salt as a precipitant, and to precipitate from concentrated and boiling solutions. After cooling ammonia is to be added, and the process then continued in the usual manner. The following analyses were made under my direction by Mr. C. E. Munroe to test the method. In the first series pure magnesic sulphate was precipitated at a boiling heat and in concentrated solutions by microcosmic salt, no ammonic chloride being present.

1. 0·6430 gr. gave 0·2914 gr. $Mg_2P_2O_7$ = 9·85
2. 1·1523 ,, 0·5210 ,, = 9·79
3. 0·7064 ,, 0·3181 ,, = 9·78
4. 0·8081 ,, 0·3666 ,, = 9·80

The formula $SO_4Mg+7OH_2$ requires 9·76 per cent. The mean of the four analyses is 0·04 per cent too high. In a second series the same process was employed, but ammonic chloride was added to the magnesic solution before precipitation. In this manner:—

5. 0·5448 gr. gave 0·2461 gr. $Mg_2P_2O_7$ = 9·76
6. 0·6684 ,, 0·3026 ,, = 9·78
7. 0·7610 ,, 0·3442 ,, = 9·78
8. 0·6408 ,, 0·2906 ,, = 9·79

The mean of the four analyses gives 9·78 per cent, or 0·02 per cent too high.

Two analyses were then made by precipitating the boiling solution of disodic phosphate after adding ammonic chloride. In this manner:—

9. 0·5407 gr. gave 0·2536 gr. $Mg_2P_2O_7$ = 10·13 per cent.
10. 0·8305 ,, 0·3881 ,, = 10·10 ,,

This method must therefore be wholly rejected, the mean error being +0·35 per cent.

The same process was then repeated, only the precipitated ammonia-magnesic phosphate at first obtained, after addition of ammonia water and perfect subsidence, was re-dissolved in dilute chlorhydric acid, and again precipitated by ammonia. In this manner:—

11. 0·5916 gr. gave 0·2686 gr. $Mg_2P_2O_7$ = 9·79 per cent.
12. 0·7371 ,, 0·3349 ,, = 9·79 ,,

The error is here only +0·03 per cent, but the method is longer in its application and less convenient than that given above with microcosmic salt. This last may, I find, be used with equal advantage in precipitating manganese from hot solutions. The precipitate is crystalline, and the process is more convenient than that which I formerly gave. A little ammonia should be added to the solution before filtering.

On the Estimation of Cobalt.—The extraordinary stability of the cobaltid-cyanide of potassium, $Co_2Cy_{12}K_6$, enables us to separate cobalt advantageously from many other metals by bringing it into this form. Wöhler first proposed to precipitate the double cyanide by mercurous nitrate, and to weigh the cobalt finally as metal. I find it particularly advantageous to precipitate at a boiling heat, and then boil for a few minutes with mercuric oxide, so as to neutralise as completely as possible any traces of free nitric acid. By precipitating from hot solutions a granular, crystalline, mercurous salt is obtained, which is very readily washed. The following analyses were made to test the method. In (1) and (2) the precipitation was effected at a boiling heat, and the precipitate was simply washed with hot water containing a little mercurous nitrate. The cobalt was, after careful ignition with free access of air, finally reduced in hydrogen. The salt employed was pure crystallised $Co_2Cy_{12}K_6$.

(1). 0·5063 gr. gave 0·0890 gr. cobalt = 17·57 per cent.
(2). 0·6785 ,, 0·1197 ,, = 17·64 ,,

The filtrate, after evaporation to dryness and ignition, gave with borax, before the blowpipe, an extremely faint reaction for cobalt. In analyses (3) and (4) the solution was boiled with HgO in small excess before filtration.

(3). 0·5332 gr. gave 0·0947 gr. cobalt = 17·76 per cent.
(4). 0·6218 ,, 0·1101 ,, = 17·71 ,,

In (5) mercuric chloride was first added to the solution, and afterward sodic hydrate, until HgO remained undissolved on boiling.

(5). 0·5855 gr. gave 0·1035 gr. cobalt = 17·68 per cent.

The formula requires 17·76 per cent.

ON THE

SO-CALLED "REDUCED" PHOSPHATE AND THE VALUATION OF OLD COMMERCIAL FERTILISERS.

By CHARLES U. SHEPARD, Jun., M.D.

IN view of the great consumption of commercial fertilisers in the Southern Country, it may be deemed proper to devote a few pages of this journal to the consideration of certain questions involved in the valuation and use of superphosphates. Although the writer feels that this article leaves much undone, to the consideration of which points he intends returning on the completion of other experiments, still he is led to publish the results of some investigations, carried on in his laboratory, in answer to the wishes of certain friends of agriculture and agricultural chemistry.

The basis of the superphosphates employed in this region is, pre-eminently, the South Carolina phosphatic rock, an impure phosphate of lime. It consists of about 55 per cent phosphate of lime, 5 to 10 per cent carbonates of lime and the protoxide of iron, a few per cent oxides of iron, and traces of magnesia and alumina, partially combined with phosphoric acid; the remainder being unimportant for our present study. The phosphate of lime is, in all probability, entirely of the character of the so-called bone phosphate, or basic phosphate of lime, *i.e.*, the chemical compound of 1 atom of phosphoric acid and 3 of lime. This form of phosphoric acid, the one important for vegetable and animal life, requires 3 atoms of base, whether they be metallic oxides (as lime) or simply atoms of water. The basic phosphate of lime is, practically considered, insoluble in water (especially in its mineral state), as is also the neutral phosphate of lime, a compound of 1 atom of phosphoric acid, 2 of lime, and 1 of water. On the other hand, the acid phosphate of lime, a compound of 1 atom of phosphoric acid, 1 of lime, and 2 of water, is highly soluble in water. The "free" phosphoric acid, also quite soluble, is an atom of this acid with 3 atoms of water joined chemically to it.

Dr. Piccard has shown (in the Swiss *Polytechnical Journal*)—(1). That a complete solution of 1 equivalent of basic phosphate of lime is produced by the addition of not less than 2 equivalents of hydrated sulphuric acid, (*i.e.*, 2 equivalents of hydrated sulphuric acid act on 1 equivalent of basic phosphate of lime to produce 2 equivalents of gypsum and 1 of acid phosphate of lime, substances readily soluble in water)—

$$3CaO,PO_5+2(HO,SO_3)=CaO,2HO,PO_5+2(CaO.SO_3).$$

The excess of water ordinarily present furnishes the requisite quantity of water to produce 2 equivalents of hydrated sulphate of lime, CaO,SO_3+2HO.

(2). By the action of more than 1 and less than 2 equivalents of hydrated sulphuric acid upon 1 of basic phosphate of lime, either of the following cases may occur:—(*a*). Where only 1 equivalent of sulphuric acid is taken, and subsequent changes in the mixture are arrested by an early separation of the soluble and insoluble portions; in this case one-half of the basic phosphate of lime is converted into acid phosphate of lime and gypsum. (*b*) Where the mixture is allowed to stand for a long time, and opportunity is thus afforded for the completion of chemical reaction, the acid phosphate of lime (formed from one-half of the basic phosphate by the action of the acid) reacts upon the remaining undecomposed basic phosphate, producing the intermediate neutral phosphate of lime, $CaO,2HO,PO_5+3CaO,PO_5=2(2CaO,HO,PO_5)$.

In his studies concerning superphosphates,* R. Jones, assistant at the Kuschen Experimental Station, comes to the following conclusions as the result of a long series of interesting and careful experiments:—

(1). The superphosphates are not unchangable mixtures of gypsum, acid phosphate, and undecomposed basic phosphate of lime; but they contain the soluble phosphoric acid in the form of free phosphoric acid and acid phosphate of lime, the insoluble phosphoric acid as basic and neutral phosphate, and, in rare cases, in combinations which stand between the neutral and acid salts. Sulphuric acid is contained in them in the form of gypsum, and only exceptionally do any considerable quantities of free sulphuric acid appear to occur in them.

(2). These different chemical combinations are undergoing a constant interchange of elements; which decompositions produce, according to the external conditions and the quantity of sulphuric acid employed, an increase or a decrease in the amount of soluble phosphoric acid.

(3). A decrease takes places in every superphosphate, independent of the amount of sulphuric acid employed, where it loses in water, either by the action of artificial heat, or from long exposure to dry air. Again, "going back" (or the conversion of phosphoric acid from soluble into insoluble forms) takes place, independent of the amount of water which they contain, in such superphosphates which contain a large amount of basic phosphate of lime, in consequence of the employment of an insufficient quantity of sulphuric acid.

(4). An increase in the amount of the soluble phosphoric acid can only take place where, in consequence of the use of large quantities of sulphuric acid, the insoluble phosphate of lime contains more phosphoric acid than is present in the neutral phosphate.

The preceding observations have reference, it is true, more especially to the continental high-grade superphosphates, which, when freshly manufactured, contain from 10 to 25 per cent of soluble phosphoric acid, equivalent to from 20 to 50 per cent of bone phosphate dissolved, but they apply also to the articles prepared and sold in America. These latter, being manufactured from articles containing basic phosphate of lime, carbonate of lime and iron, oxides of iron, magnesia, and alumina (partially joined to phosphoric acid), present for our study causes of a reduction of the soluble phosphoric acid other than the large amount of originally unacted-upon basic phosphate of lime, always present in superphosphates prepared from South Carolina rock by the application of a comparatively small quantity of sulphuric acid. In this case, whatever carbonate may have remained undecomposed will most likely suffer decomposition from the action of acid phosphate of lime, the results being the liberation of carbonic acid and the substitution of the metallic oxide (previously combined with carbonic acid) for atoms of water in the acid phosphate; thereby reducing it to the insoluble condition. Whatever free alumina or peroxide of iron may be present in the superphosphate acts in a similar manner. Where sulphate of iron or alumina have been formed by the action of sulphuric acid, there is no reason to fear a *direct* exchange of elements between them and the acid phosphate of lime. At another time I hope to speak of the modifications of these reactions produced by the liberal use of alkaline chlorides.

Having thus endeavoured to introduce some of the causes for the decrease in soluble phosphoric acid of old superphosphates, I would here call attention to various methods which have been employed to determine the degree of reduction. It is well to state that the desideratum is a method by which the amount of the decomposed phosphate of lime in a superphosphate can be determined; the soluble phosphoric acid having been previously extracted by water. This decomposed phosphate, whether wholly or partly a lime salt, may be either the neutral or the precipitated basic phosphate. It is requisite that the solvent for the decomposed phosphate shall not attack to any considerable extent the undecomposed phosphatic basis of the superphosphate, otherwise the results are indeed questionable. The weaker vegetable acids* have been recommended as fit solvents for the reduced phosphates, but they are liable to the above objections. Again, the ammoniacal salts of carbonic and certain vegetable acids† have been used for a like purpose. Without entering upon a detailed criticism of the results of the treatment of superphosphates and pulverised raw phosphates by other chemists, nor upon my own investigations in this direction, I would mention that the bicarbonate and succinate of ammonia do not dissolve the neutral and freshly precipitated phosphate in a sufficient degree to allow of their use. The oxalate of ammonia is an admirable solvent of these phosphates, but, unfortunately, it attacks the raw basic phosphate so as to vitiate the analytical results. The neutral citrate of ammonia, however, while it dissolves nearly entirely the neutral and

* *Annalen der Landwirthschaft*, b. 56.

* J. A. Chesshire, Chemical News, July, 1869.
John Hughes, *Ibid.*, August, 1869.
Francis Sutton, *Ibid.*, October, 1869.

† Dr. J. König, *Annalen der Landwirthschaft*, bd. 58.
Dr. Fresenius, *Zeitschrift für Analytische Chemie*, x.

freshly formed basic phosphates of lime (as also those of alumina and iron, König) dissolves but very slightly the finely ground mineral phosphate.

Thus König found by *boiling* for one half hour a weighed amount of ground Lahn phosphorite, rock not dissimilar to South Carolina phosphate, in a sufficient quantity of neutral citrate of ammonia, that less than 2·50 per cent of phosphoric acid, or about $\frac{1}{12}$th of that in the rock, was taken into solution. On the other hand, Fresenius, who does not allow the temperature of the mixture to reach blood-heat, did not dissolve more than $\frac{1}{8}\frac{1}{0}$th of the phosphoric acid. The difference in these results may be due to the difference in the temperature of the neutral citrate of ammonia while acting upon the phosphate.

In the following determinations of reduced phosphate I followed the method prescribed by Dr. Fresenius in his *Journal of Analytical Chemistry*, and published a year ago.

(1). My first object was to ascertain the effect of the neutral citrate of ammonia upon the finely ground mineral phosphate. To this end a sufficient quantity of the reagent was allowed to act upon the fine phosphate for half an hour at a temperature of about blood heat.

Material A.—Sample of the phosphatic dust from over the mill stones of the Stono Works, kindly furnished me by Dr. St. Julien Ravenel.

B.—Sample of a cargo of Coosaw River phosphate, ground exceedingly fine by hand. This cargo had been ascertained to contain 27·20 per cent phosphoric acid by Dr. Aug. Voelcker, of London :—

		Before Treatment.	After Treatment.
A.	PO_5	26·86 W.	24·28
	,, ...	27·22 W.	24·22
	Average	27·04	24·25
B.	PO_5	27·29 S.	—
	,, ...	27·12 W.	—
	Average	27·20	24·75

The analytical results marked with W. are by my assistant, Dr. W. D. Wamer; those with S. are my own. The determinations of phosphoric are always, unless it is stated to the contrary, by the molybdate of ammonia method.

The above analyses give a difference of 2·79 per cent for A, and 2·45 per cent for B, in the amounts of phosphoric acid before and after treatment with the neutral citrate of ammonia. Bearing in mind the low temperature of the above digestions, the probability seems warranted that, in this finely divided condition, the South Carolina phosphate is soluble to the extent of 1 part in 10 to 12 in the reagent employed. If these figures are corroborated by additional analyses which I propose instituting at an early day, the greater value of these local phosphates will be established, since they will be shown to be easier decomposed by the weaker class of solvents.

It must be remarked, however, that the physical condition of the material acted upon was, from its extreme fineness, remarkably adapted for the action of the solvent; much more so than the coarser ground rock which serves as the base of the ordinary superphosphate.

(2). A number of ammoniated superphosphates which had been manufactured during the fall and winter of 1870-71, and analysed at that time by me, were subjected to a second analysis during the past winter, more especially with a view of ascertaining the condition of the phosphoric acid in them.

The first determinations of phosphoric acid were executed by the protochloride of uranium method, as is customary in this laboratory with freshly prepared fertilisers; the subsequent ones by the molybdate of ammonia method, with the exception of those for the soluble phosphoric acid, which were made by the previous method.

The articles examined were :—

A. Superphosphate containing a very small quantity of fish scrap.

B. Superphosphate ammoniated with a larger amount of fish scrap and with Peruvian guano.

C. Superphosphate ammoniated as the previous one.

D. Superphosphate ammoniated with dried flesh and guano.

	Analyses in 1870-71, Phosphoric Acid.		Analyses in 1871-72, Phosphoric Acid.			Loss in Soluble Acid.	Excess of Reduced over Loss in Soluble.
	Soluble.	Insoluble.	Soluble.	Reduced.	Insoluble.		
A.	3·74	—	3·34	2·19	14·70	0·40	1·79
B.	2·68	11·73	2·55	1·85	13·12	0·13	1·72
C.	4·38	8·43	3·42	2·32	9·27	0·96	1·36
D.	4·31	8·72	3·45	2·91	10·70	0·86	2·05

In nearly every case the percentage of total phosphoric acid in the old fertiliser will exceed that in the new by from 2 to 3 per cent; this increase being due to the loss of moisture, which ranges from 10 to 15 per cent in the ordinary superphosphates, as a result of their being kept through the hot summer.

Additional analyses of samples of various fertilisers kept in my laboratory for several years show similar results.

E. A superphosphate analysed in spring, 1869.

F. Ditto, ammoniated with flesh, analysed in summer, 1869.

G. Ditto, ammoniated with sulphate of ammonia, made and analysed in winter 1869-70.

H. A superphosphate which, while in bulk, was thoroughly drenched by a freshet in the fall of 1870, kindly furnished me by Dr. St. Julien Ravenel.

	(1). Analyses, S. Phosphoric Acid.		(2). Analyses, W. Phosphoric Acid.			Loss in Soluble Acid.	Excess of Reduced over Loss.
	Soluble.	Insoluble.	Soluble.	Reduced.	Insoluble.		
E.	5·86	8·26	3·95	4·35	5·70	1·91	2·44
F.	4·55	10·27	3·68	3·85	8·78	0·87	2·98
G.	5·54	—	2·93	4·26	11·67	2·61	1·65
H.	—	—	—	2·53	10·02	—	—

The preceding analyses indicate very clearly the truth of the theories advanced with regard to the method of reduction of the soluble phosphoric acid, which process takes place pre-eminently at the expense of the mineral basic phosphate of lime. For, even allowing a solubility of the mineral phosphate in the neutral citrate of ammonia, to the same extent as we observed in the cases of the very finely powdered phosphate, *i.e.*, $\frac{1}{1}\frac{1}{0}$th to $\frac{1}{1}\frac{1}{8}$th of the amount of phosphoric acid, there is still in most of the analyses a considerable quantity of reduced phosphoric acid *in excess* over the difference between the two determinations of soluble phosphoric acid, *i.e.*, over the loss of phosphoric acid; or, in other words, the amount of reduced phosphoric acid is greater than the sum of the loss in soluble acid, *plus* that amount of acid which we have reason to believe would be taken up by the reagent employed.

Perhaps at another time we may return to this subject. At present we call attention to a few considerations which must have weight in the valuation of all old superphosphates.

As a result of the completed chemical action there will be a larger amount of decomposed phosphate in the old fertiliser than in the new. This decomposed phosphate consists of a smaller amount of soluble phosphate, and a larger amount of phosphate insoluble in water but soluble in the reagents which in their action nearest approach the processes of the soil.

Jones found, in his investigations above cited, that the different phosphatic bases on being treated with sulphuric acid in proportion to their percentages of phosphoric acid (as also of carbonate of lime contained in them) afforded different results. Thus, old superphosphates made from Navassa burnt bone, and a mixture of the latter with phosphorite contained a comparatively large amount of neutral phosphate of lime; while those manufactured from Baker's Island guano and the Spanish phosphate contained less neutral and more decomposed basic phosphate of lime; the larger amount of neutral phosphate in the former being most likely produced by the action of the reducing agents before mentioned (especially the oxides of iron) on the acid phosphate of lime.

Bearing in mind the greater richness in phosphoric acid of the neutral than the basic phosphate, since for the same amount of lime it contains nearly one-third more phosphoric acid, and its solubility in weak reagents, it is not strange that Picard should have expressed himself as follows:—"It is hence impossible to estimate their value (superphosphates) by their percentage of soluble phosphoric acid, since one which is deficient in phosphate soluble in water can contain much which is decomposed. Therefore it follows—what at first appears paradoxical—that the value of a superphosphate as a manure is raised by the decrease of its percentage of soluble phosphoric acid, which, as is well-known, is contrary to the ordinary usage in estimating the value of a fertiliser."*

Does, then, in our experience, a superphosphate diminish in value by remaining in store for a year or even longer? In the absence of the direct answer, which must come from the agriculturist, the following considerations will have weight in forming an opinion on the subject. And since the pure superphosphates are used to only a small extent, comparatively, in the South, we will consider at once some of the changes produced in an ammoniated superphosphate, such as is generally employed, by being kept over a season:—

(1). There is a relative gain in weight of the valuable ingredients from a loss of a greater or less quantity of moisture. (2). The ammoniacal matter suffers a moderate decomposition, by which it is made more easily assimilable by the plant, without losing much, if any, ammonia; provided a sufficient quantity of sulphuric acid was originally employed. (3). As a result of the effects of heat and pressure the fertiliser becomes more uniform in composition, and is physically improved by the disappearance of the small particles of mineral and organic matter. (4). There is a loss in the amount of soluble phosphoric acid, whether free or combined, and an increase in that of the phosphates soluble in those reagents which approximate the solvents of the soil.

It is unnecessary here to dwell upon the well-known precipitation out of solution of phosphoric acid and phosphate of lime, in every well-drained and chemically considered normal soil. It is in view of this fact that chemists regard the chief function of sulphuric acid in a superphosphate to be that of disintegrating the mineral phosphate, so that, when the article is brought into the soil, the then precipitated particles of phosphate can be readily absorbed by the plant. The ultimate action of the acid in some cases, as may be inferred from the preceding pages, is little else than that of a complete chemical subdivision.

On the other hand, the solubility of a salt renders its equal distribution through a soil much more perfect than the most careful system of manipulation can produce with an insoluble one, and this is, perhaps, the great advantage derived from the use of a highly soluble phosphate. Whether this physical and certain chemical advantages, such as its quicker reaction on, and liberation of, the dormant nutritive elements of the soil, more than compensate for the advantages above enumerated, we must leave to be answered by comparative field experiments. I will add that, so far as I have been able to learn, the experience of the planters has shown no difference between the effects of freshly prepared and old fertilisers.

The statements of M. Alfred Dudouy* are the only authority on this subject which I have been able to collect from the foreign journals. In his article "On the Superphosphate of Lime and its Manifold Effects," he writes:—

"A commencement has been made in France to use the precipitated phosphate or the neutral phosphate,† which offers the phosphate of lime to the plant precisely in the condition in which the acid phosphate returns for absorption by the spongioles of the radicles. We have had comparative experience which has shown to us the good effects of the precipitated phosphate, effects at least as pronounced as those of the acid phosphate, the amounts of phosphoric acid applied being the same. This equality of effect must, in our estimation, depend on the minute division of the precipitated phosphate, and also upon the nature of the soil previously well manured, and thus containing a large quantity of carbonic acid, and of potash ready for assimilation. But still we give our preference to the acid phosphate of lime, and for these reasons." The reasons are those previously mentioned by me. In conclusion, then, we can expect good results from the use of precipitated or reduced phosphates in a soil rich in organic matter, and thus capable of affording a large amount of carbonic acid, the great solvent of plant food.—*American Chemist.*

ON THE ENERGIES OF THE IMPONDERABLES,

WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from p. 30).

Lecture II.

The Energy of Gravity, with especial reference to the Measurement of it.

The energy of gravity is one of the most silent and all-pervading of the energies of the imponderables. Although we may not be conscious of the fact, there need be no doubt that, were this energy to cease, we should be like those whom Milton describes as

> "Upwhirled aloft
> And sent transverse, ten thousand leagues awry,
> Into the devious air."

This calamity is averted by gravity putting forth that energy allotted to it by the Creator, and the work thus done enables us now to sit at ease, and gives us houses in which to dwell.

If, then, it be asked, where do we find this energy? we may say, "Look around." In this room, gravity, inasmuch as we are at rest produces but a static action; there is, however, a clock ticking, and there gravity is producing motion. The combined harmonious operations of the energies of gravity and vitality brought us together this evening. Thus it has been ever since the creation of man; and yet there is good reason for the surmise that the energy of gravity, even if known, was little regarded in the earlier ages of the world. A history of observations

* The writer cannot, without further experiment, indorse this opinion, since the circumstances which led Dr. P. to this statement are widely different from those in America. Dr. P. has reference undoubtedly to superphosphates which contain originally much more soluble phosphoric acid than those used here.

* *Journal d'Agric. Pratique*, No. 13, 1872.

† The neutral phosphate of commerce is a precipitated phosphate, formed by the precipitation of soluble phosphate with burnt lime or the carbonate of lime. Dr. N. A. Pratt has recently kindly furnished me with a sample of precipitated phosphate of lime, as prepared by his patented process. The percentages of phosphoric acid and lime in this article have been found, in my laboratory, to coincide pretty nearly with the formula $2CaO,HO,PO_5$, or the neutral phosphate of lime. I have prepared for my own experiments this same salt by the action of chloride of calcium in excess upon the common phosphate of soda.

on the energy of gravity, or even of traces of the recognition of this energy in these ages, has yet to be written. Whether, by some of the early Greek writers, gravity was supposed to be a power innate, as a living principle—a spirit in every particle of matter; or whether this power had a residence at the centre of the earth; or whether it resided in an atmosphere surrounding each particle of matter; or whether Seneca, who lived about 38 A.D., was moved, by a consideration of (to him) that mysterious principle we call gravity, to notice that the tides and the moon were somehow related, need not this evening concern us.

From the time of Seneca we may pass over more than fifteen hundred years, to the days of Galileo (A.D. 1600), who was perhaps the first person to notice that bodies in falling moved faster and faster. He attributed this to the effects of gravity, and considered that if he could retard speed whilst still permitting gravity to act, he might determine the law of increasing spaces in equal successive times. This he did by permitting a ball to roll down an inclined plane; friction on the plane caused the retardation, whilst gravity alone caused the motion. Thus he obtained the ratio of spaces in reference to succeeding times; but he made no attempt to measure the absolute spaces when a body fell freely.

Next to Galileo, in order of time, must be placed Kepler, a German astronomer, who, about 1615, in his search after certain astronomical relations, existing apparently through the mutual attraction of the planets each on the other, was led to surmises respecting the universality of the mutual influences of material bodies.

The succeeding fifty years present a blank in reference to inquiries or investigations respecting gravity. Then came Robert Hooke, who was at the same time a mathematician, an astronomer, and a mechanician. He was secretary to the Royal Society of England, and, from 1669 to 1674, seems to have frequently turned an inquiring mind to the nature of that influence which he thought he could observe to be exercised by the sun and earth upon others of the planetary system.

The great, and now (1873) universally recognised, law upon this subject was first laid down by observations and reasonings of Sir Isaac Newton, which, even at this day, are regarded with an almost religious veneration by the advanced and intelligent men of every nation. Although it is said that Newton began in 1670 to form more clear conceptions of the law of gravitation than had been propounded by any of his predecessors, we must remember on what surmises he had to build.

Kepler, about 1615, and Robert Hooke, about 1666, had led Newton, so early as the above-named date (1670), to form these conceptions, and it is probable that he was confirmed and directed in his anticipation by the fact that Richer noticed, in 1672, that a pendulum conveyed from Paris (lat. 48 deg. 50 min. N., long. 2 deg. 20 min. E.) to Cayenne, in South America (lat. 4 deg. 56 min. N., long. 52 deg. 20 min. W.) did not vibrate in the same time. This recorded fact was as a demonstration to the mind of Newton of the deviation of the figure of the earth from perfect sphericity, and its oblateness, or compression at the poles. It was not, however, until the publication of his "Principia," in 1687, that the law of gravitation was fully established and enunciated.

Briefly expressed, the law, as anticipated by others and propounded by Newton, is this—that the attraction of one planet upon another depends upon the masses (not upon the "weights") and distances of the two planets; not, however, is the law of increase or decrease such, that at one half of a distance or double of any distance is the intensity of the attractive force doubled or halved. This might be a first impression. Astronomical facts refused to conform themselves to such a law. They rebelled. The parliament of planets had prescribed another code for the inter-relationships of their mutual attractiveness, and although it might perhaps have been readily inferred that, as the distance between the attracting bodies was increased, the intensity of attraction would be decreased, yet the law of that decrease was the one which Sir Isaac Newton announced. It is this—that if there be two heavenly bodies, say, the earth and the moon, and that these at a known distance are mutually exerting a certain attraction or drawing each to the other; then, if the distance be doubled, the influence will only be one-fourth of what it was. If the distance be trebled, then this influence will become one-ninth of what it was; if quadrupled, then one-sixteenth of what it was. Expressed in precise phraseology, the law of gravitation is that of the inverse square of the distances. Thus far satisfied the requirements of astronomers.

It is remarkable how much of the utilised information men possess has been derived from the observations of astronomers. The mechanism of the universe was known before Harvey discovered the circulation of the blood, or Watt constructed a steam engine. The astronomers seem to have been the pioneers of every branch of human knowledge. The Old and the New Testaments open astronomically. "In the beginning God created the heaven and the earth" (Gen., i., 1). "The wise men from the east came to Jerusalem, saying, where is He that is born King of the Jews? for we have seen His star in the east" (Matt., ii., 2).

It must be remembered that the science of astronomy in one important respect differs from all other sciences. Astronomers are observers only—they ascertain causes by watching effects. They cannot interfere with or alter the causes in operation. They cannot make experiments. That man presumed too much upon the powers of his astronomical friend who, having invited him to bring some of his acquaintance to see an eclipse of the moon by the aid of a telescope, and, arriving too late, assured those who accompanied him that the astronomer was not only a personal friend, but also a very kind-hearted man, and he did not doubt that the eclipse would be done again in order that they might see it. Yet upon these observers all experimenters erect their fabrics. The gigantic and uncontrollable phenomena, and all the laws of the universe of planets—of the ebb and flow of the tides, of meteorology, of terrestrial magnetism and its connection with the sun, are the results of observation. They could never have been known by experiment; indeed, we could not so interfere with them as to make an experiment. Remember, experiment is an interference on our parts, and a re-directing of energy into a new channel, in order that that may be observed which cannot otherwise be observed. Hence, if we wish to utilise observation it must be by the adaptation of an experiment in the presence of an observation—to contrive, in fact, a system of apparatus which may enable us to take observations, and at the same time to so control the elements of an experiment as to bring them within the range of our means of observation.

Such combination of experiment and observation is to occupy much of our attention this evening, as on the records of these men—Cavendish, Atwood, Kater, Sabine, and Baily, especially Captain Henry Kater, are built our system of measures and weights; for to them we are indebted for what must constitute a court of final appeal, should the time ever come when our present standards, being totally lost, it is essential to re-establish them.

The energy of gravity is peculiar, and differs from those other energies with which we are to be concerned, in that it seems inexhaustible—its power is not proportioned to the work it does. All other energies are in process of exhaustion by work when that work is measured by motion; not so gravity. Imagine a large ball, and a second small one, which gravitates towards it—the number of these small balls may be increased, and still the influence of gravity on each ball is as intense as though there was only one small ball; no exhaustion from work done affects the energy of gravity, and yet it

seems not to have any power of recouping its expended energies. There is no elasticity about it—at least, none in the hands of men.

For example, we can, in food, avail ourselves of affinity, and so, through the agency of assimilation, revive the energies of an exhausting vitality. Electricity can, upon a system of relays, or upon its extraordinary property of induction, renew at a distance, not only its pristine vigour, but an energy many-fold greater than its original one. Light can have its intensity and purity restored by heat. Gravity remains in its solitariness. True, we believe that vitality, affinity, electricity, light, and heat are independent of, and beyond the influence of, gravity; yet we know them not—we cannot bring them within the ken of our senses, except when they are associated with what owns the dull, dead, inert, and yet powerful influence of the energy of gravity. For all means yet employed have failed to develop or detect the presence of these imponderables in a *perfect vacuum*.

This fact seems to give support to the suggestion that the "potential energy of gravitation may be, in reality, the ultimate created antecedent of all motion, heat, and light at present existing in the universe."

The mode in which we estimate or measure gravity is peculiar. It is the only one of those energies with which this course of Cantor lectures has to deal that tells its story upon a scale-beam or spring balance. No concentrated rays of a tropical sun have ever caused an appreciable deviation of the most delicate balance; neither light nor heat imparted to a body *in vacuo* has ever required the fraction of a gramme to be added to the other scale-pan. But, when gravity is concerned, we cannot add the most minute microscopical molecule without having the equilibrium disturbed.

Gravity alone, of all the imponderables, rises up equal to the burden laid upon it. Its power seems to increase with the amount of matter involved or work to be done. The more required from it, the more it does. You cannot overburden it. An avalanche of rocks or a gossamer thread are equally the playthings of gravity.

For the purpose of these Cantor lectures, the law of gravitation which binds the planets in their courses is of little concern, unless we find that the same law binds the material elements with which we are concerned. The question whether the influence whose law Sir Isaac Newton so clearly propounded resulted from an unknown and ungovernable something, resident and centralised, as it were, within the planets, or whether it was a property of every molecule or group of molecules, was not set at rest until Nevil Maskelyne, the Astronomer-Royal at Greenwich, went to Mount Schiehallien, in Perthshire, in 1774, to calculate the density of the earth.

The mountain of Schiehallien has very steep sides. Mr. Maskelyne suspended plumb-lines from two opposite and nearly vertical sides. Now, if those plumb-lines deviated from what one may call verticality, they would have been caused to deviate by the attraction of the mass of the mountain. Thus Maskelyne examined this—he had an instrument by means of which he could, by observations upon the stars, determine the exact direction that the plumb-line should take, and he found that the strings did not take that direction. Having done that on one vertical side of the mountain, he repeated the experiment on the other side, and found that the deviation there was opposite to that which it was on the first side.* Having determined that these strings no longer followed the vertical, he formed an estimate of how much this mountain attracted the plumb-bob at the end of the string, and so arrived at a conclusion that each particle of matter does attract every other particle. This was the first approximation to an estimate of that which forms a very important element in connection with other experiments. We may here state that in certain regulator-clocks the makers put the single weight in the corner of the case, so that, being removed to the greatest distance, its influence upon the pendulum-bob, similar to that of Schiehallien upon the plumb-bob, may be the least possible.

This, then, established the fact that the power whose law Newton discovered was no gnome resident in some mysterious terrestrial centre, but was a property of every molecule of matter, and could not by any means or contrivance be separated from those molecules. Whether this property be within the molecule, or only in what may be called the atmosphere around the molecule, may be left to those who arrange theories.

(To be continued.)

* The deviation was noted by a zenith-sector, and after making the requisite corrections there was left an attraction which caused the two lines to be drawn together, so including an angle of 12 seconds due to the mountain.

NOTICES OF BOOKS.

Third Annual Report of the Deputy-Master of the Mint, 1872.

IN this official report, with its fourteen appendices, we meet with a variety of important information. We learn, for instance, that the "machinery of the Mint was constructed between the years 1805 and 1816, since which time nearly every appliance of minting in other countries has been gradually changed, while in this country but little advance has been made, and the result is that, although the English Mint is bound by law to coin with much greater accuracy than foreign mints, its machinery is less efficient than that of even the least well-appointed mint in Europe." That such a state of things is not creditable to a country which boasts of being the fruitful mother of mechanical improvement will be readily admitted, and we have not the smallest doubt that such impediments are a "constant source of anxiety" to the Department, and of needless expense to the nation.

The differences of assay reports come very naturally here under notice. We read that "when the reports of the Assayer of the Mint, by whom gold ingots imported for coinage are assayed, do not agree with those of the trade-assayers by which the ingots are accompanied, the former almost invariably indicate the presence of less gold than the latter." It is a fact but too well known to the initiated that large operators in bullion generally press the assayer to give high returns. If he, feeling certain that he is right, declines to "cook" his results, they withdraw from him their patronage. Thus a class of "high" assayers have sprung up, whose reports very naturally do not agree with those of the Assayers to the Mint.

The Annual Report gives some curious information concerning the coinage of other countries. We learn that in Japan the mint is being placed upon an improved footing, and that large sulphuric acid works, under the direction of an English superintendent, are in course of erection.

The most interesting portion of this pamphlet is naturally the "Memorandum" of Mr. Roberts, the able and energetic Chemist to the Mint. According to this document, 30,334 assays have been made during the year—19,446 of gold, and 10,888 of silver. The amount of "brittle gold," set aside as unfit for working, was 17,000 ozs., whilst, during the year before, it was no less than 40,000 ozs. Mr. Roberts is enabled to state, as the result of his experience, that the "chlorine process" for toughening brittle gold is the most effectual method hitherto devised. The new process of spectroscopic assaying devised by Mr. J. N. Lockyer, F.R.S., has been experimentally tested. Mr. Roberts is of opinion that the use of the spectroscope for quantitative analysis well deserves careful examination. He states that, whilst the existing method—the gold-parting assay—"affords results

which are trustworthy to the 1-10,000th part of the weight of the assay piece, in the examination of a series of gold-copper alloys by means of the spectroscope differences of composition more minute than the 1-10,000th part can be readily distinguished. By the spectroscopic method, too, the value of the assay piece can be determined in a few methods, whilst an assay by the ordinary method can hardly be completed in less than two hours. Mr. Roberts does not describe the exact method of manipulation, which has not been finally decided upon.

Traces of gold, enough to render their separation remunerative, have been found in the worn-out silver coinage, and in this manner 81·27 ozs. of gold have been recovered from 117,048 ozs. of old crowns and half-crowns. Among the appendices is an interesting, but long, correspondence on the preparation of new trial-plates of gold and silver.

CORRESPONDENCE.

ON BUTTER.

To the Editor of the Chemical News.

Sir,—I cannot agree with Mr. Martin Murphy that the fat globules in milk have no "enveloping tissue or coating." A drop of milk under the microscope—using 1-50th focal length—shows the field full of capsules containing fat, with a small proportion of free oil globules, some being very minute. When treated with acetic acid the globules coalesce; but chloroform does not dissolve the fat in the capsules without agitation, whilst the free oil globules instantly vanish into that liquid.—I am, &c.,

Charles A. Cameron.

Dublin, July 29, 1873.

ON BUTTER.

To the Editor of the Chemical News.

Sir,—In addition to the methods for the detection of the adulterants in butter, which have of late appeared in the Chemical News, would specific gravity not be of importance if carefully applied? Supposing a portion of butter was taken, melted, raised to a temperature sufficient to melt the bodies resulting from a mixture of pure butter with an adulterant—so that their specific gravities could be compared at the same temperature—and its specific gravity taken.

Make mixtures—say with 1 to 10 per cent of the adulterant and pure butter; get these to the same temperature ascertain their specific gravities, compare with pure butter, and note the difference.

Specific gravity is very useful in many such examinations. If any one has tried experiments of that nature on butter, and if it would not be too much to ask, I would, through curiosity, like to know a little of the results.—I am, &c.,

George Alston.

London, July 22, 1873.

THE BUTTER CONTROVERSY.

To the Editor of the Chemical News.

Sir,—With all due deference to Dr. Campbell Brown, as I was so much longer in the field on this subject than Dr. Ballard, it would have been but courteous if he had begun at the *beginning*; as Dr. Ballard himself in his paper (see Chemical News, vol. iv., p. 283) alluding to my communication (vol. iv., p. 230), as also in vol. iv., p. 309, admits that I was about the first to publish anything like a satisfactory test on the subject; and in that very paper (vol. iv., p. 309) I called attention to he *microscopic* characteristics of butter and lard, after which followed several other letters between us on different kinds of fats. *Litera scripta manet.* I have seen nothing yet to disturb my views, or throw any new light on the matter; but I do not like my labours to be altogether ignored. notwithstanding it is twelve years ago since my communications were made in the Chemical News.—I am, &c.,

John Horsley, F.C.S.,
Analyst to the County of Gloucester.

Cheltenham, July 29, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, July 7, 1873.

Heat of Combination in reference to the Solid State; a New Thermic Expression of Reactions.—M. Berthelot.—A thermo-chemical paper. The author gives an account of the heat of solution of monobasic salts, including formiates, acetates, benzoates, picrates, nitrates, chlorides, bromides, iodides, cyanides, &c.; of the bibasic salts, sulphates, oxalates, tartrates, and carbonates. He then examines the relations between the heats of solution, the formation of crystalline hydrates, of acid and double salts, the reciprocal displacement of acids in salts and saline double decompositions.

New Isomer of Valerianic Acid.—C. Friedel and R. D. Silva.—The authors have in a former communication described pinacolic alcohol derived from pinacoline by hydrogenation, and have announced that the oxidation of this alcohol reproduces pinacoline, and that the latter, in turn oxidised by bichromate of potassa and sulphuric acid, yields an acid isomeric with the valerianic. They have since continued the study of this acid, which they have named *pinalic*. They observe that it has a considerable resemblance to the trimethylacetic acid of Boutlerow.

Mode of Decomposition of Explosive Bodies, Compared with the Phenomena of Supersaturation.—P. Champion and H. Pellet.—The name of explosives is given to compounds or mixtures which under various circumstances liberate a volume of gas whose rapid formation causes an explosion more or less powerful. In certain cases, as in the powders of which common gunpowder is the type, the explosion is derived from combinations between the elements which compose. In others, as in the substances of indefinite composition—such as the ethers of the mono-atomic and poly-atomic alcohols, the fulminates, the compounds of nitrogen with several non-metallic elements, &c.—the explosion results from the violent separation of the elements. This definition appears limited to a restricted number of phenomena, whence the authors have concluded that, in order respectively to distinguish bodies with regard to their rapid decomposition, a classification into stable and unstable would be more appropriate to this kind of phenomena. From this point of view we might designate as unstable the bodies or compounds in which the equilibrium, if broken in one point and under given conditions, determines the immediate decomposition of the whole mass with a rapidity and an evolution of heat depending

on the nature of the body and on the circumstances to which it is exposed. A great number of unstable bodies can manifest their change of state in different manners, either by a rapid decomposition giving rise to a true detonation, or by the more gradual separation of the component elements. Dynamite and gun-cotton, which can be decomposed by ignition, flame, or a violent shock (such as that of a detonator), present a striking example of these facts. The name which the authors propose might also be extended to modifications of the physical state. It is now only one step to compare the unstable state of equilibrium of explosive compounds with that of supersaturated solutions, as Gernez has done. The authors have sought to establish precise analogies between the phenomena which accompany the different modes of action of supersaturated solutions and of unstable compounds, among which they have selected dynamite, on account of the facility with which it undergoes decompositions of different grades. Supersaturated solutions may be considered as unstable compounds of water and of a hydrated salt, in which dissolution is effected by contact of a crystal of the same salt or its isomorphs. This crystal represents the detonating primer which effects the rapid decomposition of nitro-glycerine. In fact, whilst a few decigrammes of fulminate of mercury induce the explosion of dynamite, iodide of nitrogen, sufficient in quantity to be mechanically equivalent to the fulminate, is unable to explode the dynamite. In presence of a suitable charge of fulminate of mercury, dynamite explodes, whatever is its quantity and whatever may be the form of the containing vessel. A sufficient weight of sulphate of soda, at ordinary temperatures, determines the crystallisation of supersaturated sulphate even in those cases of "desensibilisation" which will be examined below. The diameter of the tubes containing the sulphate of soda, and the shape of the recipients, are without influence on the speed of crystallisation. A supersaturated solution, enclosed in a tube with several elbows and having a length of 48 centimetres, has crystallised in the same time as a similar solution placed in a straight tube of the same length. If the primer is insufficient, the dynamite undergoes merely a partial decomposition, and in certain cases does not ignite. On its part, supersaturated sulphate of soda presents different crystallisations, resembling the modes of action of the primer. Supersaturated solutions crystallising under the influence of particles of sulphate of soda contained in the air, yield long crystalline needles. If, on the contrary, voluminous crystals of sulphate of soda are introduced into the solution, a confused crystallisation prevails, and the crystals appear partly broken. The addition of an inert body in excess (silica, &c.) to nitro-glycerine completely modifies its sensibility, and transforms it into a compound which even resists energetic shocks. A corresponding result is obtained with supersaturated solutions. To 50 c.c. of a supersaturated solution of sulphate of soda were added—

	Crystallisation, caused by Atmospheric Dust, is Effected in—Seconds.
Water, 2 grms.	37
Glycerine, 2 grms.	41
Chloride of sodium, 2 grms.	40
Nitrate of potassa, 2 grms.	51
Carbonate of soda, 2 grms.	62
Sulphate of ammonia, 2 grms.	64
Sulphate of soda, 46 grms., in water, 72 grms.	114
Replacing the glycerine with syrup of sugar, 100 grms.; water, 50 (?)	177
Glycerine at 28°, 12·5 c.c.; supersaturated sulphate of soda, 25	360
Water, 72 grms.; sulphate of soda, 46 grms., saturated with carbonate of soda	900

If, to 25 c.c. of a solution of supersaturated sulphate of soda, we add 12·5 c.c. of a solution of nitrate of potassa saturated in the cold, the mixture can be left exposed to atmospheric dust without effect. Crystallisation can only be induced by the direct introduction of sulphate of soda in crystals of an appreciable bulk. The addition of foreign bodies acts, therefore, in a similar manner both with nitro-glycerine and with supersaturated solutions, which results from the separation of the molecules, and the difficulty which each experiences in undergoing the influence of the neighbouring molecule. As to the action of temperature, by reason of the very nature of the phenomena between which it is sought to establish analogies, we comprehend that their action must be inverse in the two cases, in order to give place to comparable phenomena. At low temperatures the explosive power of dynamite, and of explosives in general, decreases notably, whilst, in the same conditions, the instability of supersaturated solutions augments rapidly. A charge of 0·2 c.c. of fulminate of mercury is without action upon dynamite at 75° cold. A supersaturated solution of sulphate of soda, placed in a tube, crystallised in 39 seconds at a temperature of 15° to 16°; whilst, at 8°, the crystallisation was completely effected in 19 seconds with the same depth of liquid. A similar inversion of results was again produced on introducing into a supersaturated solution a pulverulent body, and if, reciprocally, the silica, which serves as an absorbent for nitro-glycerine, is replaced by any solvent. Wood-spirit, added to nitro-glycerine in the proportion of ¼ to ½ per cent, prevents it from exploding, but, in this case, the very nature of the body is seriously modified. On the other hand, the presence of a sufficient quantity of an absorbent, like silica, prevents supersaturation. In these experiments with dynamite, the nitro-glycerine may be replaced with any analogous compound, such as nitro-glycol, nitro-erythrite, &c. The foregoing series of facts appear to the authors sufficient to establish a direct relation between the phenomena of supersaturation and those presented by explosive bodies.

Transformation of Succinic Acid into Maleïc Acid.—M. E. Bourgeon.—Maleïc acid has been converted into succinic acid in certain phases of fermentation, and the same transformation is effected in an analogous manner and more regularly under the influence of hydrogen. The author has observed an inverse reaction whilst examining the effects of heat upon the succinate of silver; part of this salt is split up into silver and maleïc acid, according to the following equation:—$C_8H_4Ag_2O_8 = Ag_2 + C_8H_4O_8$.

Action of Chloride of Benzyl upon Naphthylamin.—Ch. Froté and E. Tommasi.—On causing chloride of benzyl to react upon naphthylamin in heat, in presence of a small quantity of zinc-powder, the authors obtained a compound isomeric with cresyl-naphthylamin, but differing from the latter in the substitution of an equivalent of benzyl for an equivalent of cresyl. Benzyl-naphthylamine melts at 66° to 67°, whilst its isomer melts at 79°. Its composition is—

Carbon	87·59
Hydrogen	7·20
Nitrogen	5·34

Experimental Researches on the Action of Nitrous Oxide Gas.—F. Jolyet and T. Blanche.—A physiological paper. The authors conclude, from their experiments, that pure protoxide of nitrogen cannot maintain the respiration either of plants or animals. Seeds refused to germinate in an atmosphere of this gas.

Crystalline Forms of the Lanarkite of Scotland.—All. Schrauff.—The crystals measured by the author contain no more carbonic acid than those analysed by Pisani.

New Clinical Researches on the Localisation, in the Anterior Cerebral Lobes, of the Action by which the Brain Concurs in the Psycho-Physiological Faculty of Speech.—M. Bouilland.—The author distinguishes two centres in these lobes—one having reference to the act of pronunciation the other to the words themselves.

Optical Telegraphic System Realised, during the Siege of Paris, by a Commission Appointed by the Governor. M. Laussedat.—This gives the contents of a sealed packet deposited with the Academy in April, 1872. (An Italian journal has recently described a similar system to that experimented with during the siege). The principle of the apparatus is this—Conceive two telescopes, *ab* and *a'b'*, directed towards each other so that their optic axes coincide. Behind the telescope *a'b'*, and near its eye-piece is placed a light, *e.g.*, the flame of a candle. If the distance is not too great, and the observer looks through the telescope *ab*, he will perceive the image of the flame as a bright point. If the distance between the telescope is increased, it will be necessary to increase the intensity of the luminous source, or the aperture to the objectives. The brightness of the image, as seen through *ab*, depends on the elements now mentioned (intensity of source, distance, aperture) and on the state of the atmosphere. A screen is inserted and withdrawn at proper intervals, being worked with a Morse instrument. The signals are rendered invisible to all but the operators. Such apparatus was furnished to some of the Paris forts; the maximum distance was that between Valerien and Fort de Nogent, 20 kilometres. A balloon left Paris in December, during the siege, with apparatus for connecting Paris thus with the provinces; and M. Lissajous gives a report of the attempts made, in some cases with success. The system was successfully used by day (and with sunlight) in General Chanzy's army.

Constitution of the Sun and the Theory of Spots.—M. Vicaire.—Reserved.

The Cyclones of the Sun Compared with those of our Atmosphere.—M. Tarry.—M. Faye, instituting a parallelism between solar and terrestrial cyclones, asserts a movement of rotation from above downwards. The Italian spectroscopists deny this descending movement as regards solar cyclones. The present writer asserts that, in the terrestrial, the rotatory aspiration is from below upwards. A whirlwind sucks up trees, roofs of houses, the water from ponds, &c. A cyclone passing over Sahara raises great quantities of sand, which afterwards fall, frequently, on the Mediterranean and in the south of Europe. Further, if the air were sucked down, it would become hotter as it descended, and the vapour it contained would not be precipitated in form of rain; now the passage of cyclones is always marked by heavy rains. This error of M. Faye's does not, in the author's opinion, vitiate his theory, which M. Tarry only wishes to put on a firmer basis. The cyclones in the sun suck up first hydrogen, then denser matters. The metallic vapours are condensed in the colder regions, and fall back in liquid drops to the interior. All the facts urged by the spectroscopists against M. Faye's theory become arguments in its favour, if we only modify the theory as stated.

Some Details of the Earthquake of June 29.—M. Fonvielle.—The centre of the catastrophe was in the Marino valley, in the district of Vittorio. Two days before, the lake of Santa Croce suddenly fell several feet, and rumblings were heard in a village on the north side on the 28th. Some streams which enter and leave the lake became muddy after the earthquake, one taking a red colour, as of blood. The churches contained a good many people, and several were killed by falling stones. The telegraph lines were broken at various points, showing great violence of oscillation. The earthquake was felt in Italy, in Germany, in the Tyrol, and even as far as Munich. A very violent whirlwind appeared at Vienna at the same time, carrying off the captive balloon to a distance of 30 kilometres. Other details are given.

Revue Scientifique de la France et de l'Etranger, July 12, 1873.

This number contains a lecture by Prof. C. Bernard, on the "Formation of Sugar in the Liver and the Blood."

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxi., No. 11, July 10, 1873.

New Electric Pile.—M. Zaliwski.—The author takes two porous cells, one of which fits very loosely in the other. Into the inner cell, containing the carbon, he pours nitric acid; into the other, sulphuric acid; and into the outside non-porous containing-vessel, fitted up with a cylinder of sheet-zinc, a saturated solution of sal-ammoniac. The arrangement of the liquids is, therefore, nitric acid, sulphuric acid, solution of sal-ammoniac.

Artificial Butter.—Ordinary fats are composed of three substances—Stearin, which is as hard as wax; margarin, of the consistence of butter; and olein, a liquid. When these three are separated by chemical means, the first may be employed for candles, the second for butter, and the third for lubricating machinery. A company is at present operating upon beef-fat, at No. 45, Newark Street, New York. In taste and in appearance the butter thus made is exactly similar to the best butter made from cows'-milk. Prof. Parof, the inventor, hopes to drive genuine butter completely out of the market. (Margarin may have the consistence, but can never possess the flavour, of butter, which depends upon small quantities of butyric, capric, and caproic acids; very similar operations are being conducted in England, the raw material being the fat of horses obtained from the knackers).

Albumen Obtained from Milk.—M. Schwalbe has found that by adding one drop of the oil of mustard to 20 grms. of cows' milk, the casein is transformed into albumen. If this discovery is confirmed, it will be of great importance in the art of calico-printing.

Natural Red Silk.—M. Ruimet des Taillis, writing in the *Chronique de la Société d'Acclimatation*, states that, by feeding silkworms on vine leaves, he has obtained cocoons of a magnificent red, and, by employing lettuce, others of a deep emerald-green. M. Delidon de Saint Gilles, of Vendée, has obtained silk of a beautiful yellow, other samples of a fine green, and others again of a violet, by feeding the silkworms on lettuce or on white nettle. He points out that the silkworms must be fed on mulberry leaves when young, and supplied with the vine, lettuce, or nettle leaves during the last twenty days of the larva-stage of their life.

No. 12, July 17, 1873.

Cure for the Bites of Gnats.—Claude Collas.—The remedy is the application of sinapised paper.

Means of Accelerating the Germination of Plants.—Dr. Grouven.—The seeds were steeped in an aqueous solution of nitrate of potassa, containing 5 per cent of the dry salt.

On Silica.—Dr. E. Robert.—Observations and speculations on the formation and transformation of siliceous minerals.

Properties and Uses of Kieserite.—A paper, extracted from the *Scientific American*, on the commercial applications of the Stassfurt salts.

Ozokerit Candles.—Ozokerit is found in beds in the sandstone of Slanik, in Moldavia, in the neighbourhood of mines of coal and of rock-salt; it has also been discovered in the Carpathians. The material in its crude state is brown, greenish, or yellow; it is translucent at the angles, and its fracture is resinous. It is naturally brittle, but when softened can be kneaded like wax. It blackens on exposure to the air. It becomes negatively electric on friction, and exhales then the aromatic odour of a hydrocarbon. It melts at the low temperature of 66°. Its illuminating power is such that 754 ozokerit candles give a light equal to 891 of paraffin, or 1150 of wax.

Explosive Antimony.—If a slip of copper is attached to the negative pole of a battery, and a slip of platinum to the positive, and if these two electrodes are plunged into a solution of chloride of antimony, the latter meta

is deposited upon the copper in a brilliant layer. After having been well washed, the antimony, which is very brittle, is detached. It detonates violently, with evolution of light and heat, if rubbed in a mortar or struck with a hammer.

Preparation of Stuffs against Moths.—Dr. Reimann recommends to steep the stuffs for twelve hours in the following solution:—Dissolve in hot water 4·534 kilos. of alum and 9·68 kilos. of acetate of lead. Let the sulphate of lead settle; draw off the clear liquid, and add 818 litres of water in which a little isinglass has been dissolved. After steeping, the goods are dried and finished in the ordinary manner.

Mineral Caoutchouc.—This remarkable substance, which is now imported from Australia, is found at Coorong in thin layers. On analysis, it appears to have a generic relation with petroleum.

Alcohol from Mosses and Lichens.—This manufacture has spread from Sweden to Russia, and is now carried on upon a large scale. The produce is considered of good quality, and is obtained to very great advantage.

No. 13, July 24, 1873.

This number does not contain any original chemical matter.

Zeitschrift fur Analytische Chemie. No. 1, 1873.

Determination of Phosphoric Acid in Baker Guano and Similar Phosphatic Bodies.—C. Gilbert.

Appendices on the Same Subject.—R. Fresenius; Max Märker; G. L. Ulex.

Experiences in Chemical Jurisprudence. 1. Detection of Prussic Acid.—Heinz Struve.

Detection of Grape-Sugar along with Dextrine and Similar Bodies.

A Method of Determining Sulphur of General Applicability.—A. Sauer.

Precipitation of Magnesia.—F. Mohr.

Contributions to the Qualitative Examination of the Vine-Leaf.—C. Neubauer.

Comparative Determinations of Alcohol.—A. Kraft.

Analysis of Nickel and Cobalt Ores and Furnace Products and on a Convenient and Accurate Method of Separating Zinc from Nickel and Cobalt.—R. Fresenius.

Avoidance of Explosions in the Use of Apparatus for Generating Hydrogen Gas.—R. Fresenius.

Bulletin de la Societe Francaise de Photographie. No. 6. 1873.

Application of Aniline to Photography.—M. Tronquoy.—A solution is prepared containing sulphuric acid and some grammes of bichromate of potassa. A sheet of paper is saturated with this liquid in the dark; it is allowed to dry, and then placed under the design in a frame. The design is reproduced on the paper in a straw-colour. It is taken out, and exposed in a box to the vapours of aniline. By its action the bichromate and chromic acid not reduced take a colour varying from green to blue-violet. It is washed in abundance of water.

Photo-Chemical Researches on the Use of Gaseous Developing Agents, and on the Influence of the Molecular State as regards Sensibilisation.—M. Merget.—The gaseous bodies experimented upon were hydrogen, sulphide of hydrogen, and the vapours of iodine and mercury.

Dark Chamber called "Composition Chamber," making it possible to obtain a Landscape from Separate Positions, which are then Combined in Single Proof.—M. Deflubé.—An account of an ingenious contrivance which may probably prove of great importance in landscape photography.

Modifications of the New Carbon Processes called "Contact-Mariotype" and "Pressure-Mariotype."—A. Marion.—The new procedure is a combination substituting alum and blended papers for the fatty inks, without the intervention of light.

Polytechnisches Journal von Dr. E. M. Dingler, No. 4, 1873.

Apparatus for the Quantitative Determination of Carbonic Acid in Saturation Gases.—B. Wackenroder.

Contribution to our Knowledge of Juniper Berries.—E. Donath.

Note on the Determination of Paraffin in Stearic Acid Candles.—E. Donath.

Formation of Vinegar.—L. A. Buchner.

Transfer of Photographic Membranes to Articles of Glass, Earthenware, and Wood.—J. Schnauss.

Archives des Sciences Physicales et Naturelles. June.

Absorption of the Chemical Rays by the Atmosphere of the Sun.—H. C. Vogel.

Bulletin de l'Academie Royale des Sciences des Lettres et des Beaux-Arts de Belgique, No. 5, 1873.

Derivatives of Glycerine.—L. Henry.

Chlorinised Aceto-Nitriles.—L. Bisschopinck.

On Iced Alcoholic Beverages Reduced to Very Low Temperatures.—M. Melsens.

Remarks on the Volatility of Cyanic Compounds.—L. Henry.

MISCELLANEOUS.

British Association for the Advancement of Science.—In consequence of the illness of Dr. Joule he will be unable to preside over the meeting at Bradford, which commences on the 17th of September, and the Council have therefore appointed Dr. A. W. Williamson, F.R.S., to the office of President for the year. The following shows the Vice-Presidents and Officers of the Association, as well as of the various sections and departments:—Vice-Presidents elect—the Earl of Rosse, F.R.S., F.R.A.S.; Lord Houghton, D.C.L., F.R.S.; Mr. W. E. Forster, M.P.; the Mayor of Bradford; Mr. J. P. Gassiot, D.C.L., F.R.S.; Prof. Phillips, D.C.L., F.R.S.; Mr. John Hawkshaw, F.R.S., F.G.S. Local Secretaries for the meeting at Bradford—the Rev. J. R. Campbell, D.D.; Mr. R. Goddard; Mr. Piele Thompson. Local Treasurer for the meeting at Bradford—Mr. Alfred Harris, jun. General Secretaries—Captain Douglas Galton, C.B., R.E., F.R.S., F.G.S.; Dr. Michael Foster, F.R.S,, Trinity College, Cambridge. Assistant General Secretary—Mr. George Griffiths, M.A. General Treasurer—William Spottiswoode, M.A., LL.D., F.R.S., F.R.G.S. Auditors—Mr. John Ball, F.R.S.; Mr. J. Gwyn Jeffreys, F.R.S.; Colonel Lane Fox. F.G.S. The sections are the following:—A. Mathematical and Physical Science.—President—Prof. Henry J. Stephen Smith, LL.D., F.R.S. Vice-Presidents—Prof. Balfour Stuart and Prof. Henrici. Secretaries—Prof. W. K. Clifford, M.A.; J. W. L. Glaisher; Prof. A. S. Herschell; and Prof. Forbes. B. Chemical Science.—President—Dr. W. J. Russell, F.R.S. Vice-Presidents—Prof. Roscoe and I. Lowthian Bell. Secretaries—W. Chandler Roberts, F.C.S.; Dr. Armstrong; and Prof. Thorpe. C. Geology.—President—Prof. Phillips, D.C.L. Vice-President—W. Pengelly. Secretaries—Louis C. Miall; William Topley, F.G.S.; R. Tiddeman. D. Biology.—Vice-Presidents—Dr. Beddoe and Prof. Rutherford, M.D. Department of Zoology and

Botany. Secretaries—Prof. Thiselton-Dyer and Prof. Lawson. Department of Anatomy and Physiology.—Secretaries—E. Ray Lankester and Dr. Pye-Smith. Department of Anthropology.—Secretaries—F. W. Rudler, F.G.S., and J. H. Lamprey. E. Geography.—President—Sir Rutherford Alcock. Vice-Presidents—Major-Gen. Sir Henry Rawlinson and John Ball. Secretaries—H. W. Bates, F.L.S., F.R.G.S.; Keith Johnston, F.R.G.S.; and Clements R. Markham, C.B. F. Economic Science and Statistics.—President—Mr. W. E. Forster, M.P. Vice-Presidents—Dr. Farr; Lord Houghton, D.C.L.; E. Baines, M.P. Secretary—J. G. Fitch, M.A. G. Mechanical Science.—President—W. Froude, LL.D. Vice-President—A. Bessemer. Secretaries—H. M. Brunel; J. N. Shoolbred; H. Bauerman.

Quekett Microscopical Club.—The eighth annual general meeting was held on Friday evening last, July 25, at University College, Gower Street; Dr. Braithwaite, F.L.S., F.R.M.S., President, in the chair. The report of the Committee for the past year was read, and testified to the continued prosperity of the Club, which now numbers 570 members. The President delivered the annual address, in the course of which he noticed the progress of microscopical investigation in Botany and Zoology. The ballot then took place for the election of officers. Dr. Braithwaite was re-elected President; Dr. Matthews, Messrs. B. T. Lowne, T. W. Burr, and C. F. White, Vice-Presidents; and Messrs. Bywater, Crisp, Hailes, Hind, Waller, and T. C. White, were elected to fill the six vacancies on the Committee, and Mr. J. E. Ingpen succeeded Mr. T. C. White, who retires from the office of Honorary Secretary, owing to the increase of his professional duties, after four years of unremitting and valuable service. The proceedings terminated with the usual *conversazione*.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

An improved method of carbonising clay, plaster, chalk, porous stone, and other like porous materials. George Hand Smith, 8, Southampton Buildings, London. December 24, 1872.—No. 3915. My invention relates to a novel treatment of porous materials and articles or objects made thereof, whereby they are converted into materials possessing properties altogether different to those peculiar to them in their normal condition. My said invention consists in a process of treating such absorbent materials by first causing them to absorb carbon from a liquid containing the same, and then expelling the volatile portions of the carbon; and the said invention is applicable to the treatment of all substances capable of absorbing and retaining the carbon.

Improvements in utilising waste products of chemical and other works, in order to render the same applicable for building and structural purposes. William McAdam, Glasgow, Lanark, N.B. December 27, 1872.—No. 3924. The feature of novelty which constitutes this invention is the utilising of the waste products of soda-ash works, alkali, soap, iron, and other chemical works, and converting the same into bricks or blocks of solid material suitable for building and other structural purposes.

Improvements in distilling, evaporating, or concentrating saccharine and other solutions or liquids. David Crawford Miller, bleacher, Larkhall, Lanark, N.B. December 27, 1872.—No. 3926. The feature of novely constituting this invention is the causing air or vapours or gases to pass into and through the solutions or liquids to be distilled, evaporated, or concentrated.

Improvements in and apparatus for extinguishing fire. William Lattimer, manufacturer, Holme Head, near Carlisle, Cumberland. December 27, 1872.—No. 3927. The invention consists in storing or preserving the chemical ingredients which, when combined, produce carbonic acid gas or other vapours for extinguishing fire, in two or more separate vessels or compartments provided with connecting pipes, instead of combining these ingredients as now customary in the case of the "fire extinguisher." The ingredients, being kept separate until they flow from their separate vessels and unite in the delivery pipe, produce the maximum effect.

Improvements in treating liquids to be burned for illuminating purposes. Benjamin White, chemist, and Patrick Thoms Hendry, commission merchant, Glasgow, Lanark, N.B. (A communication from Joseph Hale, jun., Cincinnati, United States). December 27, 1872.—No. 3930. The invention consists in taking naphtha of a specific gravity of about 60° or 65° Baumé, and mixing every 40 gallons of it with 4 lbs, pulverised alum, 5 ozs. camphor, 2 lbs. starch (by preference that obtained from potatoes), and 4 ozs. oil of sassafras. The mixture is kept for two or three days, and is well stirred at intervals, after which the liquid part is separated by filtration, and is then ready for use.

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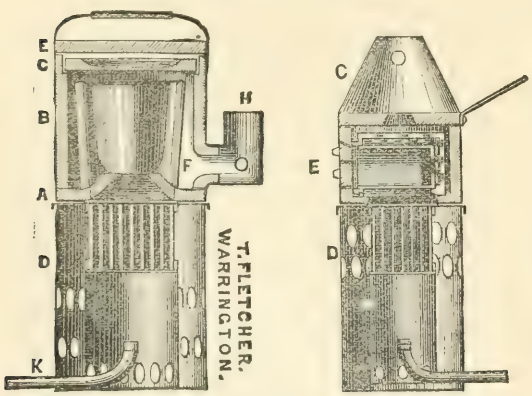

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THE CHEMICAL NEWS.

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ON THE

QUANTITATIVE ESTIMATION OF CHROMIUM,

AND THE

SEPARATION OF CHROMIUM FROM URANIUM.*

By WOLCOTT GIBBS, M.D.

The quantitative separation of chromium from uranium appears not to have specially attracted the attention of chemists. No method is given either by Rose or by Fresenius. The two metals rarely, if ever, occur associated in the mineral kingdom, and the only definite artificially prepared compound which I have been able to find noticed is the uranic chromate described by Jahn, who does not appear to have analysed the salt, though Berzelius—judging probably from the mode of formation—attributes to it a formula which we should now write $U_2O_2.CrO_4$. Berzelius also states that neutral potassic chromate gives, with uranous chloride, a yellowish brown precipitate, which contains both oxides of uranium, as well as chromic oxide and acid. This compound also appears not to have been analysed.

As the method of separating the two metals to which I finally arrived involves the presence of the chromium as chromic acid, I began my investigation by examining the commonly received methods of estimating this substance.

Rose strongly recommends the method of Berzelius, which consists in precipitating the chromic acid by mercurous nitrate, and washing with a dilute solution of the same salt. The precipitated chromate is voluminous, and has a brown-red colour when the precipitation takes place in the cold. I find that a better result is obtained by precipitating at a boiling heat, when the mercurous chromate almost immediately becomes highly crystalline, its colour changing to a bright scarlet. It may then be washed with the greatest ease, and ignited in the usual manner. It is absolutely necessary, in applying this method, that the mercurous nitrate used should be perfectly free from nitrous acid. Want of attention to this point led me formerly into an error, which I desire to correct in this place. I have stated in a former paper† that hot solutions must not be employed, on account of the reduction of chromic acid by mercurous nitrate. This reduction is not due to the temperature, but to the presence of a small quantity of nitrous acid in the mercurous nitrate employed. It is easy to avoid this source of error by dissolving the mercury in nitric acid in an open vessel, and crystallising the nitrate two or three times, using for solution dilute nitric acid which has been perfectly freed from nitrous acid by a current of air or carbonic dioxide.

To test the method thoroughly, the following analyses were made with pure potassic dichromate:—

I. Salt precipitated at a boiling heat by mercurous nitrate, and washed with hot water alone.

1. 0·6003 gr. gave 0·3030 gr. Cr_2O_3 = 50·47 p.c. Cr_2O_7.
2. 0·4741 ,, 0·2407 ,, = 50·77 ,,

The formula $K_2Cr_2O_7$ requires 51·73 per cent if we take Cr = 52·2.

II. Salt precipitated cold by mercurous nitrate, and washed with cold water only.

3. 0·2641 gr. gave 0·1344 gr. Cr_2O_3 = 50·89 p.c. Cr_2O_7.
4. 0·5098 ,, 0·2607 ,, = 51·13 ,,

III. Salt precipitated cold, then boiled, and washed with boiling water only.

5. 0·4957 gr. gave 0·2503 gr. Cr_2O_3 = 50·49 p.c. Cr_2O_7.
6. 0·6393 ,, 0·3288 ,, = 51·43 ,,

IV. Salt precipitated cold, then boiled, and washed with hot water containing mercurous nitrate.

7. 0·4951 gr. gave 0·2558 gr. Cr_2O_3 = 51·67.
8. 0·3639 ,, 0·1881 ,, = 51·69.

In these last analyses the error of the mean is only 0·04 per cent. We arrive, however, more quickly at our object when we precipitate at once at the boiling-point, and then wash with a hot dilute solution of the nitrate.

In several works on analytical chemistry it is recommended to precipitate chromic acid from its solutions by plumbic acetate, and to weigh the resulting chromate of lead. In repeated trials I have never been able by any artifice whatever to prevent the precipitated plumbic chromate from passing more or less through the filter so as to render the filtrate turbid.

Precipitation of chromic acid by a baric salt was next examined. Potassic dichromate was precipitated by baric acetate, with the following variations:—

I. Salt precipitated by baric acetate at a boiling heat, and washed with water only; chromate weighed upon a porous earthenware filter.

1. 0·4617 gr. gave 0·7894 gr. $BaCrO_4$ = 51·41 per cent.
2. 0·4685 ,, 0·8022 ,, = 51·52 ,,

II. Salt precipitated by baric acetate at a boiling heat, alcohol added, and the precipitate washed with a hot mixture of 3 parts of water and 1 part of alcohol of 90 per cent, and ignited.

3. 0·3802 gr. gave 0·6546 gr. $BaCrO_4$ = 51·78 per cent.
4. 0·5282 ,, 0·9069 ,, = 51·66 ,,

III. Salt precipitated by baric acetate without alcohol. Solution after precipitation evaporated to dryness upon a water-bath, then washed with hot water and ignited.

5. 0·5366 gr. gave 0·9229 gr. $BaCrO_4$ = 51·75 per cent.
6. 0·5355 ,, 0·9204 ,, = 51·71 ,,

In the last analysis alcohol was added to the wash-water. From this it appears that very accurate results may be obtained by precipitation with baric acetate at a boiling heat, adding a small quantity of strong alcohol to the liquid, washing with water containing alcohol, and igniting. The wash-water need not contain more than 1-12th of its volume of alcohol. The precipitated chromate must, before filtering, be allowed to settle completely, leaving the supernatant liquid perfectly clear. The filtrate never becomes turbid, even after all the soluble salts are washed out. Finally, it is not necessary to weigh the baric chromate upon a weighed filter. A very small quantity of the chromic acid is always reduced by the carbon of the filter in igniting, but the loss of weight is inappreciable. This method is much shorter than that which is usually employed, as the filtration and washing may be executed almost immediately after precipitation.

The conditions necessary for the complete precipitation of chromic acid, either as mercurous or baric chromate, having been thus carefully reviewed, I next proceeded to attempt the quantitative separation of uranium and chromium. In a first series of experiments, weighed quantities of potassic dichromate were mixed with much larger, but undetermined, quantities of uranic nitrate. The chromic acid was then precipitated by mercurous nitrate from the boiling solutions. In this manner the following results were obtained:—

Gr.		Gr.	
1. 0·4120 $K_2Cr_2O_7$ gave	0·2130 Cr_2O_3	= 51·74 p.c.	Cr_2O_7.
2. 0·3292 ,,	,, 0·1702 ,,	= 51·70	,,
3. 0·4543 ,,	,, 0·2353 ,,	= 51·77	,,

The mean of these analyses is 51·73 per cent, which is precisely the percentage required by the formula $K_2Cr_2O_7$.(Cr = 52·2).

These analyses show that mercurous nitrate gives very accurate results. The employment of this salt in separating chromium from uranium is indicated only in those cases in which the chromium exists as chromic acid, in

* From the *American Journal of Science and Arts*, vol. v., Feb., 1873.
† *Am. Journ. Sci.* [II.], vol. xxxix., p. 59.

which relatively small quantities of chlorine or sulphuric acid are present, and in which no other acid is present which, like phosphoric acid, gives an insoluble mercurous salt not completely volatilised by ignition. In the presence of chlorine, sulphuric acid, &c., the following process may be very advantageously employed. The solution is to be boiled for a few minutes with a small excess of sodic hydrate, the precipitate of sodic uranate filtered off and washed with hot water containing a little sodic hydrate until the washings no longer give any turbidity, with a solution of mercurous nitrate. The sodic uranate in the filter is then to be dissolved in chlorhydric acid, and the uranium determined in the usual manner. The filtrate contains all the chromium as CrO_4Na_2. After adding chlorhydric acid in excess, the chromic acid may be most conveniently reduced to chromic oxide by adding a solution of potassic or sodic nitrite and boiling for a few minutes, after which the oxide may be precipitated by ammonia in the usual manner. An alkaline nitrite is a better reducing agent than alcohol, as the chromic oxide may be precipitated immediately after the reduction.

It remains to consider the case in which chromic and uranic oxides occur together in solution. A solution of sodic hydrate in small excess is to be added, and the whole heated to boiling. To the hot liquid bromine-water is to be added. Chromic oxide is almost instantly oxidised to chromic acid, which remains in solution as CrO_4Na_2, while uranate of soda with a small percentage of uranic chromate remains undissolved. After washing with hot water containing a little sodic hydrate, the precipitate, which has a deep orange colour, is to be dissolved in hot nitric acid, the solution boiled for a few minutes, to expel any traces of nitrous acid, mercurous nitrate added, and the whole allowed to stand until the small quantity of mercurous chromate has settled. This, after washing, may be ignited in the same crucible with the chromic oxide obtained as above from the sodic chromate in the filtrate. The filtrate is free from uranium. Repeated attempts to determine uranium by precipitation with sodic phosphate, and final weighing as uranic pyrophosphate, have led as yet to no satisfactory results. It is, however, worth noting that the gelatinous phosphate becomes pulverulent, and easily washed by simple evaporation to dryness.

THE MANIPULATION OF HYDRIC SULPHIDE.*

By JOSIAH P. COOKE, Jun.

THE manipulation of hydric sulphide in a large laboratory has always been a difficult problem, and the inconveniences arising from the use of this reagent in the state of gas are so great that, when a class of forty or fifty students are working with it at once, the nuisance becomes almost unbearable. When dissolved in water, however, this reagent gives as little trouble or annoyance as any other; but, as ordinarily prepared, the solution is so weak that the substance under examination is deluged with water before the required excess of the reagent has been added. This objection can be wholly overcome by dissolving the gas under pressure, and drawing off the solution from a syphon like soda-water, and in any laboratory where water is supplied under pressure such a supersaturated solution can be very readily prepared with a very simple apparatus, which may be mounted in the following manner:—

We use for the purpose the common green glass bottles in which acids are usually sold by the druggists, only taking care to select strong bottles with a well rounded neck about 1¼ inches in diameter. Let us designate by A, B, and C three 2-quart bottles of this description, and by D a similar, but larger, bottle, having a capacity of 2 gallons. In A the gas is generated from ferrous sulphide, water, and sulphuric acid, in the ordinary way.

* Communicated by the Author.

We pass the gas from A, first through a wash-bottle filled with moistened sponge, and then through the distilled water with which the bottles B and C are about three-fourths filled, the gas bubbling up as usual from glass tubes leading to the bottom of each bottle, and the excess not absorbed by the water passing forward to the large bottle, C, which serves as a gasometer. All these bottles are fitted as tightly as possible with rubber stoppers, through which pass the stout glass tubes that conduct the gas. Through the stopper of D pass three such tubes: the first, which brings the unabsorbed gas from C, opens at the top of the bottle; the second is connected by a rubber hose with a water faucet, and reaches to the bottom of the bottle; the third serves simply as a vent. The bottles B and C are fitted each with two tubes, one to deliver the gas at the bottom of the bottle, and the second, opening from the top, to conduct away the excess. The gas generator, A, requires only an exit tube; and, lastly, the wash-bottle is fitted in the ordinary way, save only that we pack it with well-washed sponge, by which the gas is more effectually purified than when it bubbles through a liquid. We use glass tubes of about 3-16ths of an inch bore, and rubber hose of the same calibre, but very stout and made of pure vulcanised rubber. The rubber stoppers are cut from what we call *stopper cord*, which, as well as the hose, is made by the Boston Belting Company. In mounting the apparatus, we interpose 2 or 3 feet of hose between the several parts, so as to have sufficient freedom of motion to enable us to shake up the water with the gas in the bottles B and C. Over the ends of the tubes from each of the bottles B and C we stretch permanently two rubber connectors, cut from the hose just described, and depend wholly on *pressure-taps*, acting on these connectors, for closing the bottles. While charging the water with gas, the connectors are united to the hose by short lengths of glass tube, and subsequently the solution is drawn off through a bent glass tube slipped into one of the same connectors. The bottles, thus arranged, serve the same purpose as a soda-water syphon. The rubber stoppers soon become cemented to the glass, and are never removed, the bottles being filled as they are vented, through the glass tubes. A rubber connector with a pressure-tap must also be provided for the vent-tube of the large bottle, C, which serves, as we have said, to receive the unabsorbed gas. In charging the water, we leave the vent of this gasometer open until the air is expelled from the apparatus, and then connect the vent-tube by a rubber-hose with a manometer, which, if a common steam manometer is not at hand, can be easily extemporised with a glass tube and a little mercury. We now watch the pressure, and when it becomes equal to the water pressure on our faucet, we turn on the water head. On first opening the faucet it is necessary to watch the process very closely, lest the water should be forced back into the generator, but the apparatus soon adjusts itself to the new conditions, and the absorption goes on as regularly as before. The unabsorbed gas is, of course, stored in the bottle C, and gradually pushes back the water, with which at first it is three-fourths filled, into the supply pipe; but only a small portion of the gas is lost, and, with the apparatus of the dimensions described, a 2-gallon bottle is large enough to hold all the excess, which escapes before the water is saturated. To ensure perfect saturation, the water in each of the bottles B and C should be frequently shaken up with the gas, especially towards the end of the process.

We constantly use an apparatus mounted as above, with a water-head of about 30 feet. It would undoubtedly stand a much greater pressure, but a solution saturated under a pressure of two atmospheres is as strong as is desirable. For example, 100 c.c. of such a solution is more than sufficient to precipitate a gramme of antimony. For saturating 4 litres of water in an apparatus of the dimensions described above, the charge should be about 200 grms. of ferrous sulphide, about 2 litres of water, and 288 grms., or 160 c.c., of sulphuric acid. As this amount

of acid water, when at a low temperature, is insufficient to dissolve all the ferrous sulphate formed. we place the generator in front of a hot air register. In dismounting the apparatus, we close first the inlet-tube of the bottle B, and then remove the generator and wash-bottle; but care must be taken to relieve the pressure on the generator very slowly, otherwise the escaping gas will cause the acid solution of ferrous sulphate left in the bottle to boil over.

By the use of a solution of hydric sulphide in place of the gas, the consumption of ferrous sulphide in our large laboratory has been reduced twentyfold, and when it is remembered that by the previous waste the air of the room was constantly poisoned, and the waste-pipes clogged with the undissolved sulphide of iron, carelessly washed into the sinks, the advantage will be appreciated. The gain in those processes of quantitative analysis where hydric sulphide is required is hardly less important. The bubbling of a gas through a liquid inevitably entails loss, which can be wholly avoided by using the solution, and, by regulating the pressure on the tap, the reagent can be delivered in the proportions required, and at the exact point where it is wanted. Complete precipitation, moreover, is effected in a few minutes; and, if the liquid is constantly stirred as the reagent slowly flows in, the precipitate will settle in a condition admirably adapted for filtering. Lastly, the separation of sulphur, which is often so excessive when the gas is employed, is diminished, if not prevented, by using the reagent in solution.

THE INTERNATIONAL EXHIBITION OF 1873.

Chemistry may be said either to be or not to be represented in this year's Exhibition. The products of chemistry considered as a pure science would not, perhaps, afford more pleasure nor profit to the visitor than could be obtained from a call upon his druggist. Stoppered bottles, however brilliant their contents, have very much in common; but chemistry as an applied science appears under some one or other phase in nearly every process of manufacture, and the products and processes of this year's Exhibition are consequently as interesting to the technical chemist as the exhibits of years when chemistry has been expressly included.

The products of this year are chiefly related to Food—one of the most important, if not the most important, of the applications of chemical science. For much as chemistry has done for our tables and ourselves, there still remains for it to solve the problem of the proper preservation of food. Until it has solved the problem we may never hope to see in any exhibition anything better than artificial representations of the three great staple foods—meat, vegetables, and bread. For the reason that the question is yet to be fully solved, we have in this year's Exhibition a predominance of groceries and drysalteries. But these, although most important exhibits, have not the scientific nor utilitarian interest attaching to the preservation of flesh. Doubtless, without tea, cocoa, coffee, biscuits, confectionery, we should be badly off indeed, but it is possible to imagine existence as progressing in their absence. Flesh, however, is so universal a staple food, that without it existence to many of us would be not only a hardship, but probably impossible. Yet so rapidly does the price of fresh meat increase that daily the desideratum of providing some efficient means for its proper preservation becomes more pressing. Men have long recognised the importance of the question. As early as 1690 Messrs. John White and William Porter obtained from the Crown a right of monopoly for fourteen years in the preservation of flesh; and from that time to this many hundred patents have been taken out, the processes meeting with more or less success. Until this time the methods of preservation may be classed under four heads:—(1) Preservation by cold; (2) by drying; (3) by removal of air; (4) and by the use of chemical antiseptics.

Preservation by cold is a naturally established fact. In the Arctic regions, Russia, and Canada slaughtered animals are buried for months in the frozen earth and ice. Our fishmongers use ice as the chief preservative of their fish, either in over-night stock, or its progress to and from market. And it has been proposed to import from South America, Australia, and elsewhere, where meat is cheap, carcases of animals preserved in ice. Actually among the exhibits of this year there is only one of preservation by cold shown by the Atmospheric Churn Company; who, in one of their refrigerators, have some butter, fish, and a joint of meat. Messrs. Chevasse and Co. also exhibit one of their "Clifton's Patent Dry Cold-Air Refrigerators," containing the ice-chamber at the back, and feeding the food-chamber with cold air by means of valves, these valves being opened by a rod when the door is closed, and *vice versa*. External air is thus prevented entering the ice-chamber in any bulk when the doors are opened. The Piston Freezing Machine and Ice Company exhibit several of Ash's patents, the chief being the Self-Feeding Cabinet Refrigerator, arranged in such manner that the lowest temperature is available until the complete expenditure of the ice. The ice-chamber is inclined at an angle to the side of the safe, so that as the ice melts it stills bears with nearly the same surface against the food-chamber. Messrs. Howe and Shoppee exhibit an "Arctic Ice Safe" lined throughout with non-conducting white glazed porcelain tiles, having the advantage of being readily cleansed. Messrs. Kent have on view one of their "Ventilated Ice Safes," constructed on the principle that cold air being heavier displaces warmer air and descends. It is stated that in such a safe mutton may be kept for a fortnight at a temperature of 40° to 45°, and a sweetbread—one of the most difficult things to keep—for a week. Cream also has been preserved for a week. Messrs. Brainard have a model of their patent ice-house, largely employed in America; and there is a very interesting model of the ice-room of the Peninsular and Oriental Company's steamship *Cathay*.

Probably the most ancient process of flesh preservation is by drying. The Egyptians preserved birds or poultry in this manner, and the American Indians have long been adepts at the preparation of "charqui" or dried beef, the "damper" of the Australian squatter. But of this kind of preservation one does not see examples at South Kensington this year, except in the preservation of peas and vegetables together with dried and powdered meat in the form of biscuits, the chief exhibits being by Messrs. Whitehead, Messrs. Geyelin, Messrs. Warriner, Messrs. Hewetson and Co. The Prussians during the late war gave much attention to this mode of preservation, and their "Ebswurst" or portable soup is exhibited by Messrs. Johnston, who have also some meat powders. Messrs. Gillon show some dried and compressed vegetables with dried beef.

Preservation by expulsion of air is daily becoming more familiar to us, whether in the case of milk, meat, soup, or fish. This method is probably the most perfect we have, as it preserves flavour and moisture, and presents the food in a cooked form—a great benefit to the working classes. The meat, fish, or whatever is to be preserved is put into the tin in which it is to be kept, a small pin-hole being left. The tins are then immersed in chloride of calcium baths, or salt-water baths, or by other means raised to a higher temperature than the boiling-point, and the air thus expelled. From the preserving market of Aberdeen we have the greatest show of food preserved in this manner, the chief exhibitors being Messrs. Moir and Sons, who since 1822 have devoted their attention to the subject. This firm preserves as much as two-and-a-half million pounds of meat in a year, forming but a moiety of the nearly five million pounds of food put up yearly by them into tins. Messrs. Hogarth also exhibit fish and soups preserved in a similar manner in glass jars.

Messrs. Whitehead have their Australian beef and mutton and solid essences. The Ramornie Company, the first association for the sale of Australian meat, exhibit preserved Australian mock-turtle, rump-steaks, ox-tongues, beef-stew, &c., Messrs. McCall and Co. exhibit meat from Uruguay, some kangaroo-tail soup, and, indeed, kangaroo *à la mode*, and in every other mode. This firm also exhibits dried turtle for the making of real turtle soup. Messrs. Gillon, who have employed since 1817 a large number of hands in the preservation of meat, exhibit specimens of the essence of beef, condensed mutton, and chicken juices, Scotch broth, cockie-leekie, haggis, and other preserved dishes in which a Scotchman doth most delight. Then we have the Ballarat Meat Preserving Company; and, dear to the heart of Anglo-Indians, the preserved curries from Mr. Halford—*chef* to a former Governor-General of India. Two fowls here, preserved in tins, can be bought for seven and sixpence. The Food Preserving Company (late Forbes and Co.) exhibit results of Jones's patent process. In this process a vacuum apparatus is employed to withdraw the air from the tins, and by this means much of the over-cooking arising from the expelling process is avoided. A model of the apparatus is shown. Mr. Tallerman, of the Australian Meat Preserving Agency, has in the western annexe some meat actually in process of preservation on the chloride of calcium baths, and considerable exhibits of Australian veal and lamb. Of condensed milk, by the process which is now so well known to the public, there are exhibits by the Aylesbury Company, who also show coffee and cocoa combined with milk.

The preservation of meat by antiseptic processes is not illustrated in this year's Exhibition, unless we include the use of salt as an antiseptic. Chemistry does not appear to have solved the problem of preservation by means of a tasteless, innocuous agent; for of most processes hitherto known, even after much washing of the meat, there is considerable danger of the occurrence of disagreeable flavour.

Passing from Food to Confectionery we find many interesting illustrations of machinery and processes. Walking down the machinery transept the visitor's attention is attracted by immense revolving bulged-in copper vessels, in which he find almonds and carraway seeds are in course of conversion into sugar-plums and comfits. These seeds are caused to roll over and over, and thus gradually collect a coating of the hot clarified sugar which is added to them from time to time. When a moderately thick coating of sugar has been imparted another coating is given, and when of the desired size the colouring matter is poured into the pan. The exhibits under this head are by Messrs. Allen, and by Messrs. Hill and Jones. A little further on will be found an exhibit by Messrs. Batty illustrating the method of preparing oranges for marmalade: a disintegrating flour mill by Messrs. Carr and Cunningham; and apparatus for cutting and moulding sweetened gum into jujubes by Messrs. L. Collier. Messrs. Coleman exhibit the apparatus employed in separating mustard from the seed; and the Compagnie Francaise, machinery used in the preparation of cocoa. Messrs. Criscuolo, Kay, and Co's machinery for the preparation of maccaroni naturally is an object of interest to the visitor. It is stated that the Italian wheat from which the maccaroni is prepared contains on the average 15 per cent flour, 24 per cent bran, 16, 3, and 42 per cent respectively of semolina of second, first, and superfine qualities. An ingenious method of sifting and cleaning wheat is shown by Messrs. J, N. Sears and Co. The principle consists in causing the grains to meet a blast of air by which the refuse is removed, and the heavier grain allowed to descend into the hopper.

Leaving for a time the machinery annexe we enter the Australian Court. Here the chemist will be much interested in the specimens of mineral wealth of our colonies. There are exhibits of gold imbedded in quartz, and a superb lump of malachite. The specimens of copper ore from the Moonta mine are remarkably fine, and we understand that 18,000 tons of such ore is yielded yearly. The greater part of the ore is yellow sulphide, but there are specimens of quartz and purple sulphide ranging as high as 50 per cent, with peacock ore (copper pyrites) at 30 per cent. There are chlorides at 45 per cent; and some rare specimens of black and crystallised oxide, together with some grey sulphide, attain to 75 per cent. The Wallaroo mine sends specimens of green copper carbonate; and the Mount Balhannah mines exhibit specimens of bismuth. Kauri gum is also an interesting exhibit. This gum is obtained from swamps formerly covered by Kauri trees by spearing the ground until gum exudes. It is then dug out, and forwarded to the hands of the varnish maker.

The Victorian annexe contains further exhibits of Australian preserved food, hams and bacon, tinned meat, &c., and a very valuable attempt to preserve fresh uncooked meat in an ice-room. It is stated that a vessel under the care of Mr. Harrison, the inventor, is on her voyage to England with 100 tons of meat thus preserved on board.

In the Russian annexe, too, there are exhibits of tablets of dry meat and game prepared by M. Wladislas Kleczkowski, Messrs. Kittarg's packets of dried vegetables, dried mushrooms on strings, dried green peas, &c.

As a journal of physical and applied science, our report would not be complete without some mention of the machinery in the annexe we have already visited. A process comparatively strange to this country is to be seen in progress at the stall of Messrs. A. Jouffray, the winding of silk from the cocoon of the silkworm. The apparatus consists of a brass-topped tables in which are inserted shallow turned boilers, the water in these boilers being heated by jets of steam, The operator, having thrown the cocoons into this boiling water, provides himself with a whisk-brush, and plunging this into the bath, collects on its fibres the filaments of the cocoons floating on the surface of the water. These filaments he then passes to a glass eye, whence it is carried to a reel turned by power. Then we come again to specimens of English manufacture, for the winding machines are from the hands of Messrs. Rushton, Son, and Co., of Macclesfield. From the "winder" the silk passes to the cleaning machine, which consists of two fixed plates, and between these the fibre is passed to detect knots and other irregularities. Next the fibre appears upon the doubling machine, where two or three fibres are run together side by side without twist, the result being termed "train." If the fibres are to be twisted they are taken to the fourth or spinning machine; the twist fibre given out by this machine being known as "Organzine." Near at hand there are similar machines by Messrs. Higginbotham, and a machine for recovering silk waste by Messrs. Greenwood and Batley. The Jacquard and other looms shown by Messrs. Warner, Sillet, and Ram, Messrs. Norris and Co., and by Messrs. Stevens we need not here dwell upon.

Objects well worthy attention are the ingenious devices for the production of aërated waters and for bottling the same exhibited by Messrs. Fleet and Co., Messrs. Hayward, Tyler, and Co., and by Messrs. Barnett and Foster. In these new methods of bottling advantage is taken of the expansive force exerted by the compressed gas, which is caused to hold a glass marble or wooden plug against a welt of india-rubber inserted in the neck of the bottle.

In the stoneware department we have an elegant piece of design by Messrs. Doulton and Co., whose collection of chemical apparatus was so noticeable last year. And, though very distantly allied, we have the apparatus for boring rock and stone exhibited by the Diamond Rock Boring Company, who show a "drill head" and "prospecting machine." Hard black diamonds are fitted into a collar, and the drill thus constructed is caused to rotate against the face of the rock as in other boring machines. But far the most philosophical instrument for working in stone is the sand-blast of Mr. Tilghman. The principle

of the apparatus is that a blast of air or steam is caused to carry a jet of sand against the surface to be abraded. A description of the apparatus has already appeared in these pages; and it will be necessary only to say that with a pressure of 55 lbs. 3-16ths of an inch of marble can be cut away in five minutes, and glass almost instantaneously engraved, a design cut in paper being first placed on the portion to be protected.

The department devoted to surgical instruments will be one of the greatest interest to the professional medical man, but to the general reader the instruments cannot well be described. The "Pneumatic Aspirator," for removing morbid fluids from a natural cavity, is perhaps one of the most recent improvements in medical appliances. It consists of an exhausting syringe of about 4 ozs. capacity, with an air-tight piston. The nozzle is bent at right angles, and is provided with two stopcocks. A hollow needle is affixed to the nozzle, and the piston being raised and the air exhausted from the instrument, the needle is introduced into the tumour. When a sufficient depth has been reached to prevent access of air the stopcock is turned, and the fluid by atmospheric pressure is drawn into the aspirator. The aspirator filled, the stopcock is closed, and the second cock opened; the piston is pressed down, the fluid discharged, the cock closed, the piston re-drawn, and the operation if necessary may be repeated.

Returning to the galleries of the Albert Hall, we find several inventions relating to railway signalling; which, however, we cannot efficiently describe without drawings. In one corner of this room are the Magneto-Electric Clocks exhibited by the British Telegraph Manufactory. The principle of these clocks is that of an unbroken circuit, which includes a coil of wire attached to the pendulum of the motor clock (and vibrating over permanent magnets) and the coil of the secondary clock. At each vibration of the pendulum coil of the motor clock an induced current is generated, which is transmitted to the secondary clock, where it actuates a set of rotating magnetic needles. A system of these clocks have been presented to the Royal Institution; and a set has been for some time working at the University of London, Burlington Gardens.

From a practical point of view the Exhibition of this year, attended as it will be, and is, by those really interested in its exhibits, shows elements of great success. This year we lose much that has been striking in former Exhibitions, but the gain in practical instruction, and as a record of real progress, is much enhanced. The Commissioners are certainly to be congratulated on the success of the year.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from p. 56).

Mr. Michael suggested to Cavendish an experiment which has ever since gone by the name of Cavendish's experiment, and from which was deduced the first pretty accurate calculation or actual measurement of the density of the earth. Cavendish, as you know, was a very wise man. It is said of him that "he was the richest wise man, and the wisest rich man, that the world ever saw." He left more than a million of money. He had also another quality which would be very desirable to cultivate in certain parts of this kingdom at the present time—he uttered fewer words than any other man who attained the same age is supposed to have done. He discovered many things, and, amongst others, he was the first to make an attempt at weighing the whole earth, and he weighed it with an accuracy which has only been confirmed in recent times.

The apparatus that Cavendish used was double the size of this which you see before you, but it was similar in construction. He had two balls of lead, similar to these large ones, suspended from a very light bar, that bar being trussed, as it is called, by a kind of triangle of wires, and the whole being attached to a hook in a pulley, round which he passed a cord, by means of which the balls of lead can be moved to any position you please. In order to exclude every external influence, the apparatus was enclosed in a room of its own, and to observe the phenomena that took place within that closed room lamps were applied at small orifices, and telescopes were placed at others. In addition to this apparatus with the two balls of lead, which weighed about 3 cwts. each (as far as my memory serves), he had another apparatus placed below the other, as you see here. From a centre immediately under the pulley to which a frame carrying the leaden balls is attached, was suspended by an exceedingly fine wire a light rod with two little balls, less than bullets, and these balls held a certain position, and could not move from it beyond certain limits. Being placed in the aforesaid enclosed room, where there were no draughts or variations of temperature, or anything external to affect them, and they had been left for some time—say, for twenty-four hours, they became stationary, and would not move unless some external force were applied to them. At the end of the light bar carrying these small balls was an ivory scale and a pointer, and upon this was directed the light of a lamp from outside the room, whilst a knob was also placed outside, by turning which the motion of the large leaden balls could be controlled. At another orifice was placed a telescope, by means of which the motion of the pointer could be observed. After the little balls had became quite stationary, by the cord he very gently swung the larger balls to a position close to the small ones, and after a certain lapse of time, varying from a quarter of an hour to an hour, he observed the space through which the small balls were moved from the position they had occupied. It may be well to state that a thorough examination had been previously made as to whether any influence could be due to magnetism.

This experiment had to be repeated very frequently, because of the minuteness of the range of these balls and the magnification of it. The application of the results was to be so important. He therefore made three experiments on each occasion, and observed the position that the balls took. He also observed another matter, which is of great consequence, although this evening to be passed over very lightly, namely, the number of oscillations made by the small balls before they came to rest. These balls oscillate like a pendulum, and by the number of times they swing before coming to rest certain calculations of great importance to the inquiry may be made. These calculations being completed, the conclusion he arrived at was that the earth was 5·4 (say 5½ times) heavier than water.

Now it is only right that you should be told ho from these balls the density of the earth can be deduced. The mass or quantity of matter in these balls is known; their attraction upon the little balls is known from observation. The mass, therefore, of any other ball being known, we can tell the attraction that it would have upon these balls. It is quite clear that if this large ball had double the mass it would have double the attraction at the same distance; if treble the mass, treble the attraction, and so on. Again, if the mass of the little ball was known and the attraction of the great one known, and the mass of the great one known, then if the mass of another ball is known, we shall get the attraction of that other ball. It should also be attempted to make clear how, from these two balls, we can weigh the earth, and probably it will keep your interest alive in the matter if informed that, in 1835 (Cavendish's experiments being made at the close of the last century,

* The Cantor Lectures, delivered before the Society of Arts.

about 1798), Mr. Baily, the founder of the Astronomical Society, repeated them. Mr. Baily had been a stock-broker in London; he retired from business, and purchased a house in Tavistock Place, the one, I believe, in which Mr. Digby Wyatt now lives. He there made many experiments, and some most extraordinary calculations, and did a large amount of astronomical work. Amongst other things he undertook to weigh the earth, and he weighed it as Cavendish did, namely, by an apparatus constructed on the same principle as the one before you. He swathed the box or chamber, in which the balls were, with flannel, and put a gilded cover over all. He also lined the inside with tin-foil, and connected it by a copper wire with the earth. These precautions were intended to neutralise, as far as practicable, changes in atmospheric temperature and terrestrial electricity. How important he considered it you may judge from this, that he made more than 2500 experiments with balls of this character; he sat watching them for 1200 hours, and that number of experiments extended over some years. The repetition was planned in 1835, commenced in 1837, and concluded in 1842. The result of these 1200 hours of watching, exclusive of the calculations which followed, led to the conclusion that Cavendish was right within a fraction of 2-10ths, that is to say, Cavendish concluded that the density of the earth was 5·4 times that of water; Baily concluded that it might be 5·6 times that of water.

It may be permitted to repeat the reasoning, in order if possible to make clearer the principle on which it proceeds. From the weights we know the masses of the large ball and of the small one. We know that the small balls in relation to the large ones were free from the influence of gravity; we also know by observation how much the one attracts the other. Double the ball, and you get double the attraction, and so on. Now, we know the size of the earth, and by placing this little ball on a spring balance we know how much the earth will attract it. Therefore, the weight of the little ball being known, and the size of the earth being known, there is nothing left except the attraction to find, and, as we have the attraction from these two balls, we can, by a simple arithmetical operation, determine that the earth is 5·6 heavier than water.

This seems the best opportunity to name that the present Astronomer-Royal (Professor Airy) investigated by very different means, and on very different principles, this question of how much heavier than a globe of water the earth is. Qualifying the conclusions from his experiments as himself suggests, consequent upon certain geological considerations, it may be asserted that Cavendish's result is very nearly correct.

Time passed by; Cavendish's experiment was made, as I told you, about 1798, and Baily repeated it about 1835. We must now go back, as a matter of history, to Cavendish's time, and the next step we arrive at in determining the energy of gravity was the experiment that was made by Atwood, who was born in 1746. He was a Fellow of Trinity College, Cambridge, and was the first to entertain the idea of devising some plan of measuring the force of gravity. Let me endeavour to make this matter clear. Cavendish determined the density of the earth, but he did nothing whatever as to determining the force of gravity. Force, as stated in the first lecture, can only be measured by motion. We can easily obtain motion from the action of gravity, but we must observe that motion in order to measure force. If a weight be let fall, it falls far two quickly to permit of an estimate of the rate at which it falls. That rate is due to gravity. Atwood thought, as Galileo had previously done, that by causing the fall to be delayed, he might be able to draw a conclusion as to the exact force of gravity, and the plan he adopted was this. You are aware that the intervals between the ticks of a pendulum vary according to its length. Here is a pendulum, and you see the rate at which it is going; if, now, the pendulum-weight be lowered, so as to lengthen the rod, you may observe that the pendulum ticks more slowly—in fact, it is now beating seconds. You were told, in the first lecture, that we must have a certain unit of measurement, and the *second* is the unit of measurement usually taken for time. If we want smaller measurements, for it is easy to divide the second into a hundred parts, they are taken by another contrivance. A very simple and efficient one is a clepsydra, or water-clock, arranged specially for this purpose.

What Atwood thought of doing in order to measure the force of gravity, having, you remember, no previous measurements to guide him (for Galileo did not touch the problem that Atwood proposed to solve), was to take two weights evenly balanced over pulleys such as these, the apparatus being most delicately made. You see that these two small weights are exactly balanced, one being at each end of a cord which passes over pulleys at the top of the apparatus, so that the weight in descending passes down in front of a graduated scale. These weights, then, are exactly balanced. Here are three very small weights, fractional parts of the ones which are suspended. If one of these small weights falls by itself, it would fall so rapidly that its rate of falling could not be observed; but if, whilst it is falling, it is caused to bring this mass of matter with it, the rate of falling will be retarded, whilst the law of the rate remains the same, *i.e.*, the law which governs the rate of falling will be similar, although the mass moved is increased. If now there be placed upon one of these balanced weights two of these little fractional weights, there is a something that will cause the connected mass to move, and this platform at the bottom will be struck about four seconds after the motion commences. The usual plan is to let the motion be commenced by electricity, which at the same time sets the pendulum in motion. You can count the strokes of the pendulum from the commencement to the end of the motion. You can see this mass of matter has been moved through eighteen spaces in four seconds. If the measure be altered, you will readily understand that these fractional weights would carry it through a different space in the same time; if other weights be put on, they would carry it through other spaces. The experiment, as made before the apparatus was brought here, shows that the force of gravity is such as to cause a body to fall through about 32 feet in one second, the meaning being that if this small weight had not been required to bring the other weights along with it, then it would have fallen from rest through 32 feet in the first second. That was the first attempt of estimating by measurement the force of gravity.

But Atwood's apparatus, though exceedingly good as matter of illustration, falls very far short indeed of that which Captain Kater adopted; and all that we have, and all that we know, of the form of the earth, and the true kinetic measure of gravity, spring from Kater's experiments, and not from either Cavendish's, Baily's, or Atwood's. Kater felt that, if instead of weights falling as they have fallen in the experiments of Atwood, he could observe the effect of gravity upon the weight falling without associating it with other weights, if it could be kept quite distinct, and if in any way he could cause gravity to repeat the operation slowly and deliberately, without any interference whatever, we might get at the conclusion much more rapidly than Atwood could by his arrangement, because the friction of the wheels, the weight of the cord, and other incidental matters affect the problem. What Kater did was to design a pendulum, of which this is a copy. It was from a pendulum like this that not only was the force of gravity determined in all parts of England, but also the form of the earth itself has been decided and estimated. Our standards of weights and measures all come from a pendulum like this. If, in

fact, the standards were all lost, it would be from such a pendulum they must be restored. Let me anticipate the conclusion by stating that when the standards were lost in the burning of the houses of Parliament they were restored by seeking for copies, because the great number of corrections and the great difficulty of counting this pendulum and freeing it from interfering causes are very serious obstacles. Few are aware of the enormous difficulty there is in placing a pendulum so as to be free from external influences, and counting the oscillations of it.

Whilst upon weights and measures, your attention may be directed to a small piece of wood here, which is a model of the standard one pound weight of Great Britain. It is one which a committee of learned men obtained, and this in my hand is a copy. The real standard is made of platinum. It is a cylinder 1·35 inches high and 1·15 inches in diameter. Observe there is a groove turned in it, and there is an ivory fork by which it is to be lifted—these standards are not to be touched. There are only five of them made, and if ever the one pound weight is lost in England it is to be recovered, not by repeating Kater's experiments, but by copying one or other of these five standards. The five are kept—one at the Exchequer Chambers at Westminster, one at the Royal Mint, one with the Royal Society, one at the Royal Observatory, Greenwich, and one is immersed in the sill of the recess on the east side of the lower waiting-hall of the New Palace at Westminster.

(To be continued.)

CORRESPONDENCE.

ON THE ESTIMATION OF MAGNESIUM AS PYROPHOSPHATE.

To the Editor of the Chemical News.

SIR,—In your last issue I observed a paper, communicated by Dr. Gibbs, suggesting the substitution of ammonium-hydrogen-sodium phosphate, $NH_4HNa(PO_4)'''$ (microcosmic salt) for the ordinary sodium phosphate, as a precipitant for magnesium. Might I add a few remarks upon this subject? Some four or five months ago, at the suggestion of Dr. W. Ramsay, I undertook a series of experiments with a view to ascertain whether or not this mode of procedure would yield good results. In my first experiments I precipitated the magnesium from a cold solution of magnesium sulphate containing ammonium chloride, but failed in obtaining results which could be considered as satisfactory. In my subsequent experiments I heated the mixed solutions of magnesium sulphate and ammonium chloride to the boiling-point, and precipitated the magnesium from the boiling liquid by adding the $NH_4HNa(PO_4)'''$ solution. After having been allowed to cool, ammonium hydrate was added, and the whole allowed to stand for twenty-four hours. The precipitate of $MgNH_4(PO_4)'''+6H_2O$ was then collected upon a filter, dried at 100° C., ignited, and weighed as $Mg_2P_2O_7$ in the usual manner. The following figures will serve to illustrate the accuracy of this process:—

Grms.		Grm.		Grm.		
1·0020	$MgSO_4+7H_2O$	=0·4550	$Mg_2P_2O_7$	=0·0685	Mg=9·83 per cent.	
1·0321	,,	=0·4675	,,	=0·1011	,, =9·78	,,
1·3820	,,	=0·6264	,,	=0·1354	,, =9·79	,,
1·0022	,,	=0·4561	,,	=0·0986	,, =9·84	,,

The mean results being 9·81 per cent. As $MgSO_4+7H_2O$, theoretically speaking, requires 9·76 per cent of Mg, this leaves an average error of about 0·04. As magnesium is a substance which analysts have frequent occasion to estimate, Dr. Gibbs's suggestions are well worthy of their consideration. For my part I can heartily recommend his process.—I am, &c.,

R. W. EMERSON MCIVOR.

Glasgow, August 4, 1873.

ADULTERATION OF BUTTER.

To the Editor of the Chemical News.

SIR,—I am taking a lively interest in the discussion on the method of detecting the adulteration of butter, and am glad that Mr. Horsley has written to remind your readers of his previous work on the subject. I have found his process very useful and practical, and have used it to a considerable extent. A simple way of applying the ether method is the following, which I copy from an article on the "Detection of Adulteration of Butter," contributed by me to the *English Mechanic* during the autumn of last year:—

"Animal fats in butter are best detected by shaking a small portion of the sample with a moderate quantity of ether, in a corked tube, at the ordinary temperature, when the butter will readily dissolve, and leave the adulterating fat as a milky fluid at the bottom of the tube: the residue when due to lard is pretty fluid, but that left by tallow or dripping has a peculiar, thick, granular appearance. The upper liquid should be poured off, and the residue washed once or twice with a little cold ether, when it may be examined under the microscope, and tasted, after warming to get rid of adherent ether. If the test be made on a mixture of pure butter with lard, tallow, dripping, &c., a few trials will show that it is capable of giving very fair results. Excess of ether must be avoided, or complete solution will take place. If the butter contains much salt or water, it is best to purify it first by melting and shaking with hot water."

The success of the test evidently depends on the sparing solubility of stearin in cold ether. Dr. Campbell Brown's method is a more refined application of the same principle. The taste of the residuary fat is quite characteristic. Pure butter sometimes leaves a slight residue, but it is free from any taste of animal fat. Although the analyst employing the above test may possibly fail in detecting a small admixture of lard, he can scarcely miss dripping or tallow, 5 per cent of the latter fat being readily recognised by the method described. The test also furnishes unscientific persons with a convincing proof of the adulteration, a fact which is not without its value.

Of course, as above described, the test makes no pretension to scientific accuracy, but by the use of definite weights of butter and ether it forms a very valuable adjunct to (and in some cases a substitute for) the more elaborate methods recently proposed.—I am, &c.,

ALFRED H. ALLEN, F.C.S.

Borough Analyst's Laboratory, Sheffield, August 5, 1873.

University of London.—The following is a list of the Candidates who have passed the recent B.Sc. Examination:—*First Division.*—Peter Phillips Bedson, Owens College; Edward Boyce Cumberland, private study; Thomas Frederick Harris, private study; Samuel Alexander Hill, Royal School of Mines; William Hudson, private study; John Viriamu Jones, University College; Oliver Joseph Lodge, private study; James Gordon MacGregor, Edinburgh University; William Rushton Parker, Caius College, Cambridge; Thomas Slater Tait, Owens College; Claude Metford Thompson, University College; Arthur Thomas Wilkinson, B.A., Wesleyan College, Taunton. *Second Division.*—William Brown, Birkbeck Institution; George Christopher, University College; George Simmonds Dunn, B.A., private study; John Gilliott Garl[illegible] M.A., St. Mary's Hospital; Charles Hopkinson, Owens College; Peter Horrocks, Owens College; John Neville Keynes, B.A., Pembroke, Cambridge, and University Colleges; William Henry Munns, B.A., University College; Frank Prior Purvis, private study; Prasanna Kumár Ráy, University College; Charles Robinson, Owens College; Herbert Robson, University College; Alexander Simpson, B.A., F. C. Divinity Hall, Aberdeen; Arthur Hewett Spokes, B.A., University College; Charles Alfred Weber, B.A., University College.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, July 14, 1873.

Mode of Intervention of Water in Chemical Action during the Mixture of Saline Solutions, whether Neutral, Acid, or Alkaline.—M. Becquerel.—The author draws the following conclusions from his experiments:—(1). In the mixture of two neutral saline solutions giving rise to double decompositions, these decompositions are brought about by the intervention of the reactions of water on the constituents of the salts. (2). In the reaction of acid upon alkaline solutions, water is still the principal agent by whose intermediation it is effected. The affinity of acid and alkali, both anhydrous, plays only a feeble part in the production of electromotive forces.

Thermic Researches on Saline Solutions.—P. A. Favre.—A thermo-chemical paper in continuation of the controversy now pending between Professor Thomsen on the one hand and certain French *savants* on the other.

Reduction of Platinum Salts by Hydrogen Gas.—M. Merget.—The author finds that salts of platinum, like those of silver, cannot be reduced by a current of pure hydrogen. If a trace of arsenic is present the reduction takes place.

Dissociation of Red Oxide of Mercury.—H. Debray.—M. Myers, who has recently investigated the same subject, has inferred that the dissociation of oxide of mercury up to a limit of 400° is quite normal, but that the tension reached does not lessen on cooling. Above 400° there is no longer a maximum tension, the decomposition becoming total after a sufficient time. The author does not consider this view justified by the experimental results of M. Myers.

Oxalines or Ethers of Glycerin and of the Polyatomic Alcohols.—M. Lorin.—Oxalic acid and glycerin give rise to oxalin, a solid white body, silky, like acetamide, hygrometric, and of a fatty aspect. If heated, it melts, gives off vapours, liberates carbonic oxide, and leaves a residue of glycerin. Ammonia converts oxalin into oxamide. Oxalic acid yields a compound resembling mannite. The author has previously pointed out the formation of a substance of the same type, resulting from the action of oxalic acid upon glycol.

"Turbinage" of Frozen Wines.—M. Melsens.—Alcohol is totally absent in ice produced in the midst of vinous liquids. The turbine used in sugar refineries to separate the crystals of sugar from the treacle is the best instrument for separating this ice from the concentrated wine.

Theory of the Planet Saturn.—M. Le Verrier.—This forms the twenty-first chapter of the author's "Recherches Astronomiques."

Note on the Isochronous Regulator constructed by M. Breguet for Observation of the Transit of Venus at Yokohama.—M. Yvon Villarceau.—This instrument appears in the Vienna Exhibition.

Modifications of the Magnetic Power of Steel by Tempering and Annealing.—M. Jamin.—Soft iron takes the greatest temporary magnetism; tempered steel receives much less; and the less, the greater the hardening effect produced. A hard bar of cast steel, annealed to red, gave a separative force of 1290 grms. for a current of twelve elements. Hardened and subjected to the same conditions, it showed a force of only 75 grms. Steels of good quality, in thin plates and greatly hardened, are absolutely unfit to become permanent magnets; poor steels retain the polarity, and may be made powerful magnets after great hardening, and without annealing. All kinds of steel attain a maximum for their co-efficient of polarity, but in different conditions; poor or average steels, after rigid hardening; rich or refractory steels, greatly hardened, after a measure of re-heating, the temperature of which is higher in proportion to the degree of previous hardening. If one wishes, with a given steel, to make the best possible magnets, this maximum must be reached, and so different steels must be differently treated, as described. There is no fixed rule (as to degree), but the particular treatment can be readily ascertained from previous treatment of a specimen. The author gives a table of values of magnetic power and co-efficient of polarity for various steels.

Degree of Visibility which can be Reached with Astronomical Telescopes of Small Dimensions.—M. D'Abbadie.

Direct Demonstration of the Fundamental Principles of Thermo-Dynamics; Laws of Friction and Impact according to this Science.—M. Ledier.—The author starts from the distinction between the motion of the *ensemble* of a system and the proper motion of its atoms; the latter being resolved into motion corresponding to change of volume in the body and vibratory motion. Having examined the various movements of atoms, he ranges the forces actuating them in three categories: (1) those measurable physically, among which are gravity, muscular force, pressure of fluids against the sides of vessels, &c.; (2) irregular molecular forces, such as act between the atoms of solid bodies; and (3) irregular or erratic molecular forces, first among which are the forces called calorific.

Note on Magnetism.—M. Du Moncel.—This refers to a recent experiment by M. Gaugain. When a soft iron armature is applied to the polar faces of a horse-shoe magnet, the magnetisation, shown by induction currents, is found increased throughout the extent of the magnet, even to the curve. He thought this to be at variance with the general idea of magnetic condensation. M. Du Moncel thinks he here confounds two different magnetic actions; one is a dynamic action, operating as in Ampère's solenoids, the centre of which corresponds to the middle of the magnetised core; and to this belong the effects of induction produced by magnets, and the attractive forces between them and the currents. The other is a static action, constituting the attractive force proper and the magnetic polarities. These two actions may be produced independently of each other. The magnetic condensation, which M. Gaugain disputes, is the result of the polar action. It is a sort of reflex action between the armature and the pole, not displacing the magnetism from one end of the magnet to the other, but calling forth, molecularly, a greater quantity of magnetism, and producing a change of orientation in the axes of the atomic polarities of magnetic molecules, which form the series of currents of the magnetic helix. Two consequences flow from this. First, the atomic polarities being super-excited, the molecular currents have more energy, and the magnetic solenoid acts with greater intensity; hence the increase of the induced currents. Second, the polarities determining attraction being displaced or concealed more or less by the reflex action of the armature, all the atomic polarities in the different parts of the magnet are displaced in the same way, in order to equilibrium. Hence, there is either a general weakening in the external polarities of the magnet when its two poles are in contact with the armature, or a weakening of one pole and strengthening of the other when the armature is in contact with one pole only. The

author adds some further proofs of magnetic condensation, or of the prolonged concentration of magnetic polar actions at the surface of contact of two magnetic pieces. One of the most curious consequences of magnetic condensation is the retardation of the current of demagnetisation in a closed magnetic system, when one interrupts the voltaic current magnetising the system.

Variable Period in Closing of a Voltaic Circuit.—M. Cazin.—The result of experiment is stated in the following proposition:—Consider a voltaic circuit, the homogeneous wire of which presents some portions straight and some wound in spiral. If we call V the potential at one point, and x the distance from this to some other point in the circuit, reckoned along the wire, the differential co-efficient $\frac{dV}{dx}$ has at each instant the same value at different points of the straight portions; it increases gradually with the time. Remaining the same at different points of the wound portion, the elements of which are subject to equal inductive actions, the co-efficient increases at first very rapidly with the time, reaches a maximum, and decreases continually till it has the same value as in the straight portions; the permanent state is then reached. Thus, in the variable period of closure, $\frac{dV}{dx}$ is not a function of the time alone; it depends on x, and on the manner in which the circumvolutions are disposed at the point considered. It is, further, proportional to intensity of current.

On a Barometer called Absolute.—MM. Hans and Hermany.—The principle is that of observing the motion of a point in the line joining the extremities of the columns in two parallel-placed thermometers, one air, the other mercury.

On a Means of Comparing Powders with one Another.—M. de Tromenec.—The author explodes different kinds of powder by electricity, within a vessel enclosed in a larger vessel filled with water, and which serves as a calorimeter. The exploding body producing no dynamic effect the force is transformed into heat, which when measured indicates the absolute force of the powder.

Researches on the History of Digestion in Birds. M. Jobert.—The gizzard is not exclusively a triturating organ but a chemical stomach, which secretes an acid liquid.

Observations on some Liquids of the Organism of Fishes, of Crustacea, and of Cephalopoda.—MM. Rabuteau and Papillon.—The authors found urea and methylamin in the peritoneal liquid of the ray, squale, torpedo, and other fishes. Chlorhydric acid was obtained from the gastric juice of the ray. The blood of the poulp and the crab gives no absorption band in the spectroscope, becomes slightly blue in air, and loses the blue tint when carbonic acid is passed through it, resuming it when again agitated with air. It contains some urea, but the blood of the squale and ray contain a much larger proportion.

Heat of Combustion of Explosive Matters.—MM. Roux and Sarran.

Revue Universelle des Mines, de la Metallurgie, des Travaux Publics, des Sciences et des Arts Appliqués a l'Industrie, March and April, 1873.

On Forms of the Hot-Blast Apparatus.—M. L. Gruner.—A mechanical paper.

Reply to M. Leseure's Note on the Memoir of Bochkoltz.—A controversial paper on the "Regenerator of Force."

Condition of Mines in the Island of Sardinia.—M. Sella.—A detailed account of the lead and zinc mines in that island, with analyses of the chief kinds of ore.

Conditions under which Supersilicated Cast Metal is produced in Blast-Furnaces.—Samson Jordan.—This paper has been previously extracted.

Auriferous Region of Frasconi.—C. Sagey.—The mineral contains, on an average, 105 grms. of gold and 62 of silver per ton, representing a value of 369 francs.

New Methods of Determining Iron and Alkalies Volumetrically.—P. Charpentier.—These methods are based on the employment of alkaline sulphocyanides, and on the well-known reaction ensuing when they are brought in contact with a per-salt of iron. If, into the red liquid formed by adding a solution of an alkaline sulphocyanide to a solution of a per-salt of iron, there be poured a caustic alkali, the red colour disappears, peroxide of iron is thrown down, the alkaline sulphocyanide being reconstituted. Other things being equal, it is necessary to add so much the more alkali the more iron there is in the original solution. To titrate the alkaline liquid employed in the operation, dissolve 5 decigrms. of pure iron in very dilute hydrochloric acid. It is very important that this solution is exempt from free acid, and that all the iron is in the state of sesquioxide, the latter condition being attained better by means of chlorate of potash than of nitric acid. This solution is diluted with water to the volume of a litre. Of this, 100 c.c. are placed in a white porcelain capsule, and a few drops of sulphocyanide of potassium are added, when the liquid takes a deep blood-red colour. By means of a graduated burette, caustic potash is then added, of such a strength that about a buretteful would be required to saturate a litre of the iron solution. The red liquid becomes gradually turbid, and then suddenly grows colourless, whilst the sesquioxide of iron is precipitated. The amount of alkali consumed is read off. The same alkali is then used to titrate the remaining 900 c.c. of iron solution. The number of degrees, increased by $\frac{1}{9}$th, is the strength of the alkali sought for. These points being arranged, in order to analyse any ferruginous matter—whether ore, slag, or mineral water—a neutral solution in water or hydrochloric acid is prepared, diluted to a litre, and, after the addition of sulphocyanide of potassium, is titrated as above. If the number of degrees found is N', then $\frac{N'}{N}$ is the proportion of iron in the body under examination, N being the number of degrees of alkali required for the standard iron solution. In case of a mixture of protoxide and sesquioxide, commence by determining the pre-existing sesquioxide as above, avoiding contact with air, and adding chloride of ammonium to hinder the precipitation of protoxide of iron. A second portion is then perfectly peroxidised, and the total iron is determined. The difference shows the amount of protoxide. In this case, it is advantageous to replace the potash with ammonia. If desired, the iron solution may also be poured into a known and fixed amount of alkali, mixed with sulphocyanide. The appearance, not the disappearance, of the red colour is here decisive. After the application of this method to any given sample, the analysis can, if required, be completed by the ordinary gravimetrical method. If the substance under examination contains substances precipitable by ammonia, and this alkali is employed, their precipitation may be hindered by means of chloride of ammonium; such substances are—Lithia, baryta, strontia, lime, magnesia; the protoxides of manganese, iron, zinc, cobalt; oxides of cadmium, silver, platinum, rhodium, osmium, and ruthenium. The following oxides are not thrown down by an excess of potash:—Lithia, baryta, strontia, alumina, glucina, oxides of zinc, chrome, lead, platinum, tin, palladium, rhodium, osmium, and gold. In this case, potash is employed as the standard alkali. In most cases, foreign substances do not interfere. This holds good with silica, the alkaline metals, the alkaline earths, alumina, manganese, zinc, cobalt, nickel, cadmium, chrome, lead, bismuth, silver, and all metals which give white precipitates with alkaline sulphocyanides. The application of the method to alkalimetry is based upon the following reaction:—If an excess of caustic alkali is present in a liquid along with a little sesquioxide

of iron recently precipitated, and if hydrochloric acid is gradually added, as soon as the alkali is saturated, the oxide of iron is attacked, and a ferric solution formed, which immediately gives a blood-red colouration, an alkaline sulphocyanide having been added as indicator. The method is, of course, acidimetric as well as alkalimetric. The author thinks that the method can be extended to the determination of silver, chlorine, and lime.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Mène, No. 50, August 19, 1872.

New Mode of Silvering Glass.—M. Siemens.—Aldehyd has been long ago employed for silvering glass by Liebig's process, though the difficulties of manipulation are considerable. Siemens has improved the process by treating aldehyd with thoroughly dry ammoniacal gas. Of this liquid 2·5 grms., and 4 grms. nitrate of silver, are taken, and each is dissolved separately in water, the total amount of which is 1 litre. The two solutions are then mixed and filtered. The object to be silvered, cleaned so as to be quite free from grease, is immersed in the liquid, and heated gradually up to 50°. When this point is reached, the deposition of the metal begins in a very thin layer, dark at first, but gradually acquiring the metallic lustre. As soon as the incrustation has acquired the ordinary whiteness and lustre, the object is withdrawn from the liquid.

New Process for Preparing Anthracen.—When coal-tar is distilled with a view to the preparation of anthracen, it is necessary to push the process to its farthest limit; that is, to separate from the tar the largest possible amount of heavy oils in which alone the anthracen is found. The process hitherto employed has failed in extracting from the tar a quantity of oil containing anthracen at all proportionate to what exists in the mass. In fact, when, over and above the light oils, a quantity of heavy oils have been withdrawn equal to about one-fourth of the weight of the tar placed in the still, the operation is stopped, since the residual matter becomes viscid, and, conducting heat badly, tends to undergo decomposition and carbonisation, to the great detriment of the apparatus, which would be rapidly destroyed if the operation were further prolonged. The residue contains a large quantity of anthracen, which has hitherto been wasted. The new process consists in the use of agitators, by means of which the yield of heavy oils is raised to 40 per cent, showing a gain of 10 to 15 above the old process. The last portions of heavy oil, moreover, are richer in anthracen than the former.

Varnish or Size from Gum-Lac.—The solvent employed is carbonate of ammonia, in which the ground gum-lac is boiled till the ammoniacal odour has disappeared. It is recommended as a dressing for dark coloured textile fabrics.

Continuous Furnace for Burning Bricks, &c.—M. Esser.—A paper derived from English sources.

Improved System of Heating Gas-Retorts.—M. Rouget.—The author attains an economy of coke to the extent of 11 per cent, by arrangements calculated to intercept the radiation of heat from the front of the furnace and from the heads of the retorts.

Influence of India-Rubber Tubes on the Illuminating Power of Gas.—M. Zulkowski.—The author shows that olefiant gas and hydrocarbon vapours are absorbed by caoutchouc. Hence, tubes of this material are not admissible in experiments on the illuminating power of gas.

Use of Steam in Extinguishing Fires.—As a means extinguishing fires, the author recommends the use of large pipes, communicating with a boiler, and capable of filling the building with steam in case of a conflagration.

Anthracen Blue.—M. Springmühl.—We have recently noticed this alleged novelty.

Scarlet Dye on Cotton with Magenta.—The cotton is first to be worked in a boiling decoction of sumac and turmeric, and then with the addition, after a few hours, of a little sulphuric acid. It is then, after cooling and washing, dyed in a luke-warm bath of magenta. (It is absurd to expect a good scarlet from any combination in which magenta is present. All magentas are more or less on the blue side of red, and even the slightest admixture of blue is fatal to scarlets).

New Galvanic Pile.—M. Chauderay.—The arrangement is intended for military telegraphic purposes.

Dyeing Wax Candles Black.—M. Bœttger.—This effect is produced by heating the wax along with Anacardium nuts.

Imitation of Leather.—A mixture recommended consists of 16 parts of gelatin and 5 of glycerin. A colouring matter is then added as may be required, caoutchouc to give elasticity, and boiled linseed oil to render the whole sufficiently flexible. This composition is spread upon linen whilst hot, printed with any pattern desired. The surface is then treated with a solution of alum, sulphate of iron, copper, or zinc. These saline solutions may likewise be mixed with the composition before it is spread on the linen. The surface is lastly varnished, and may be bronzed or gilt. Another composition is obtained by boiling linseed oil with quick-lime and borax, which forms a liquid that, on cooling, becomes a thick paste. It is then mixed with rasped cork and more quick-lime.

Rapid Process for Reducing Old Silver (Photographic) Baths.—M. de Krueger.—The mixed silver residues are well shaken up with phosphoric ether, when a black precipitate is deposited, which is filtered off, washed, and boiled in a strong potash lye, yielding metallic silver.

Removal of Potassic Salts from the Solutions Obtained in the Manufacture of Beet-Root Sugar.—Messrs. Duncan and Newlands.—The patentees claim the separation of potash and ammonia by the employment of tartaric acid or acid tartrates, and the separation of the same bases by means of sulphate of alumina.

Archiv fur Pharmacie, Band ii., Heft 6.

Microscopic Examination of Spring Water.—E. Reichardt.

On Sugar in the Roots of Grass, and on Triticin—a New Hydrate of Carbon from the Roots of Triticum.—Herm. Müller.

Examination of Aqua Amygdali.—A. Koster.

Amount of Copper in Water passed through Copper Service Pipes.—E. Reichardt.

Examination of Sausages Coloured with Anilines.—E. Reichardt.

On Antique Bronze.—E. Reichardt.

On Vanillic Acid.—P. Charles.

Action of Certain Organic Acids on the Development of Mouldiness.—H. Werner.

Neues Repertorium fur Pharmacie, No. 6, 1873.

Toxicological Studies on Hydrocotarnin.—F. Falck.

Effects of Eucalyptol.—M. Bing.

History of Eucalyptus Globulus.—M. Bing.

Influence of Absolute Alcohol upon Certain Chemical Reactions.—Aug. Vogel.

Influence of Active Oxygen upon Pyrogallic Acid.—H. Struve.

Acid Reaction of Chloral Hydrate.—H. Struve.

Rapid Method of Drying Flasks, Tubes, &c., and on a Convenient Junction of Wide and Narrow Tubing.—Emi Zettnow.

Behaviour of Camphor-Cymol in the Animal Organism.—E. Ziegler.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxi., No. 14, July 31, 1873.

Rewards for Inventions.—Count De Doubet, in the session of the National Assembly, July 22, proposed a reward of a million francs to anyone who may succeed in forming ferrocyanides, nitrates, or ammoniacal salts from the nitrogen of the atmosphere for manurial purposes, provided that such manures shall be cheaper by at least 10 per cent than the analogous manures now in the market. For the discovery of a substitute for coal he proposed the reward of a million and a half.

Preservation of Gum Arabic from Mouldiness.—Hirschberg adds for this purpose a little sulphuric acid to the solution, and finds that the mixture retains its adhesive property uninjured after the lapse of eighteen months.

Revue Scientifique de la France et de l'Etranger, July 26 and August 2, 1873.

These numbers contain no original chemical matter.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of salt, and in apparatus employed therein. Robert Williamson, salt manufacturer, and Josiah Dale, manager, Wincham saltworks, Northwich, Chester. December 28, 1872.—No. 3939. First. Brine is evaporated by steam applied directly to the upper bottom of a pan, called pan A, such steam being generated from water contained within a double bottom, the fires or flames and heating gases acting on the water-covered outer bottom. Second. Steam from pan A, or other steam, is led through a series of pipes in another pan, called pan B, such pipes being movable up and down, centre steam-tight joints being provided. Third. The movable pipes under the above second part are balanced by chains and weights over pullies. Fourth. Hot brine is supplied to pans by the feed pipe being led through hot water. Fifth. Brine, hot or cold, is supplied to pans through small apertures in pipes, or through a series of small nozzles.

Improvements in treating waste liquors containing arsenical or phosphatic compounds, and in obtaining and applying useful products therefrom. James Higgin, Manchester, and John Stenhouse, Pentonville, Middlesex. December 30, 1872.—No. 3949. We precipitate arseniates, arsenites, or phosphates from the waste liquors resulting from the so-called "dunging" process, applied for the fixation of mordants on textile fabrics and yarns, by an addition of muriate of lime or other suitable earthy or metallic salt, and, after collecting the precipitate on a filter, decompose it by carbonate of soda or other suitable alkaline salt, reproducing thereby a liquid or salt similar to that originally employed for the "dunging" process. We can, where preferable, precipitate insoluble arseniates, arsenites, or phosphates at the same time as fatty and colouring precipitates, by running the waste soap liquor and the waste "dunging" liquor into the same pit, and precipitate the mixed liquors by muriate of lime or other suitable agent, dissolving out from this precipitate the arsenites, arseniates, or phosphates by a suitable acid, and from this solution, by addition of lime or other alkaline agent, we obtain a precipitate, upon which we operate in the same manner as the precipitate from waste "dunging" liquor alone. We treat the fatty compound left, by one of the processes described in the Specification of Letters Patent granted to John Thom and John Stenhouse, dated July 22, 1872, No. 2186.

Improvements in the treatment of maize and other like grain for the production of starch therefrom, and in the utilisation of the waste products for the manufacture of cardboard and paper, and for the preparation of soaps. John Henry Johnson, 47, Lincoln's Inn Fields, Middlesex. (A communication from Eugène Leconte, Paris). December 30, 1872.—No. 3956. This invention consists of a process for obtaining starch in a rapid and economical manner from maize by mechanical means, and in applying the ligneous residues or products to the manufacture of paper-pulp, and the fatty products to the preparation of soap. The essential feature of the process is the entire and complete separation of the three component elements of the maize, viz., the starch, the ligneous and fibrous matters, and the fatty azotised matters.

Improvements in the production of iron. John Watson Spence, Newcastle-on-Tyne. December 30, 1872.—No. 3957. This invention consists in the production of iron by bringing reducing gases, or, if necessary, gases and air, under pressure in contact with oxides, or oxides and fluxes, or oxides, fluxes, and carbonising materials, in a furnace or reducing chamber, where they have previously, or not, been brought to a temperature sufficiently high to enable combination to take place, thereby reducing metals from their oxides direct as a successful commercial operation.

Improvements in the treatment of paper and other materials for the production of imitation or artificial leather. John Harrington, Ryde, Isle of Wight. December 31, 1872.—No. 3959. The invention consists in taking strong paper, and staining or dyeing it to any desired colour as a ground colour, and then colouring the surface thereof to the tint required; the paper is then glazed, and afterwards waterproofed by the application of a solution of shellac thereto. In certain cases glycerine is applied to the paper to produce a great degree of pliability; or, in some cases, the glycerine may be mixed with the dye. The paper is then, if preferred, grained as described in Specification of Patent No. 2423, 1872.

New or improved methods, processes, and apparatus for depositing upon wrought-iron, steel, and cast-iron, layers of copper or alloys of copper. John Henry Johnson, 47, Lincoln's Inn Fields, Middlesex. (A communication from Octave Gauduin, chemist, Jean Baptiste, Java Mignon, and Stanislas Henry Rouart, builders, all of Paris). December 31, 1872.—No. 3970. This invention relates to different processes and apparatus for deposition on wrought-iron, steel, or cast-iron, coats or seams more or less thick, but adherent and continuous, of copper and alloys of copper. The said processes may be summed up as follows:—1st. A dry process, and the necessary apparatus peculiarly applicable for depositing thick seams of metal, as on printing cylinders, machine chairs, &c. 2nd. A dry process of precipitation, with or without using electricity, based on the decomposition of simple or compound salts of copper kept in fusion. 3rd. A humid process of precipitation of copper and of its alloys, with or without using electricity.

NOTES AND QUERIES.

Cyanides in Gas Waste Products—Nitrous Acid from Sulphuric Acid Chambers.—I see mention made in Wagner's "Technology" of a method of utilising the cyanides in gas waste products. In the CHEMICAL NEWS it is stated that lime has been successfully used for the collection of the escaping nitrous acid from sulphuric acid chambers. Can your readers inform me if I can obtain full particulars of these processes from any source?—ENQUIRER.

TO CORRESPONDENTS.

E. W.—Communications for "Notes and Queries" column are for the benefit of the readers of the CHEMICAL NEWS. Purely business communications must be made known, in the usual manner, through our advertisement columns.

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THE CHEMICAL NEWS.

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THE CHEMICAL CONSTITUTION OF SUCCINIC MALIC, AND TARTARIC ACIDS, CRITICALLY EXAMINED AND INTERPRETED FROM THE STAND-POINT OF THE "TYPO-NUCLEUS" THEORY.

By OTTO RICHTER, Ph.D.

AMONG the leading combinations of organic chemistry, the family group comprising the water-salts of succinic, malic, and tartaric acids has always been regarded with special and absorbing interest, not only on account of the vast multitude and diversity of substitution-products and derivatives which these water-salts are capable of furnishing, but more emphatically on account of the deep import and significance which all these bodies are felt to possess in a theoretical point of view. With a well-stocked magazine of precious materials at their disposal, our modern speculators have certainly not been sparing in their efforts to unravel the genetic relations and molecular structure of this particular class of molecules. I, for my part, having, years ago, become convinced of the utter futility of these efforts, so long as they continue to be based upon the more or less crude and deceptive principles of the dominant school philosophy, and sincerely believing that my own speculations on this subject are calculated to throw a brighter and purer light upon this intricate, but all-important question, I have thought it my duty to embody the main results of my researches in the present communication. For this purpose I have drawn up the following programme, which consists of three parts. In the first part I shall expound the molecular changes that accompany the natural production of the water-salts of succinic, malic, and tartaric acids in the living organism. In the second part I shall describe the various metamorphoses which these water-salts are prone to experience under the influence of heat and oxidising agents. In the third, and last part, I shall elucidate the molecular changes that attend the artificial production of these water-salts in our laboratories.

Having now acquainted the reader with the leading topics of my programme, I shall at once proceed to direct his attention to those weighty and important matters which form the subject of the first part.

PART I.

On the Principal Molecular Changes that accompany the Natural Production of the Water-Salts of Succinic, Malic, and Tartaric Acids in the Living Organism.

The proper treatment of this question demands that I should enter first of all upon a minute analysis of the chemical origin and mode of formation of the so-called polyatomic alcohols. Apart from the well-established fact that genuine specimens of this type can be formed artificially by subjecting the corresponding hydrocarbons to the action of chlorine, and displacing the directly-absorbed chlorine molecules by an equivalent number of hydroxyl molecules, the more recent experiments of Berthelot and others, devised with the object of studying the effects of oxidising agents upon the free hydrocarbons, tend to the conclusion that these substances are produced in the living organism by the action of atmospheric oxygen upon certain kinds of native hydrocarbons, with which the juices of plants and vegetables are always more or less impregnated. Taking this for granted, and confining my remarks to that variety of hydrocarbons which are called "olefines," and whose chemical constitution is expressed in my system by the general formula $2H_{2m}C_{2m}$ ($m=1,2,3$, &c.), I shall yet venture one step farther by maintaining that the said alcohols are the true parent molecules to that particular class of combinations which claims the three acids of the text for its most familiar and most thoroughly investigated representatives.

Now I have good reason for believing that organic acids, which are descended from an olefine-begotten polyatomic alcohol, are produced in Nature's laboratory by a method which, in its general outline, may be roughly described as a process of slow and gradual combustion, in the course of which a certain number of the constituent formylic alcohols (*vide infra*) are made to pass from the category of genuine alcohols into the category of genuine acids, while the alcohol rest re-enters into chemical union with these freshly-formed acids under the typical form of a more or less complex halogen adjunct. According to this view, every olefine-begotten polyatomic alcohol contains within its sphere and substance the germs for the generation of an organic family group whose heterologous members, however widely they may differ from each other in chemical composition and properties, have this important point in common, that they contain the same equivalent number of carbon molecules as the alcohol from which they are descended. The theoretical significance of this rule will be more fully understood in the sequel, where I hope to furnish convincing proof that the three organic acids before us stand to each other in the relation of true heterologues, and that the so-called erythrit, which is a species of saccharine matter endowed with all the characteristic properties of a tetratomic alcohol, has strong claims to its being regarded as their natural and legitimate progenitor. In order to elucidate the precise nature of these curious, but, as yet, very imperfectly deciphered family relations, I shall require to inaugurate the discussion by a description of the molecular changes which accompany the aforementioned process of slow and gradual combustion from one stage of the process to the other.

The first effects of the action of oxygen on a given olefine are supposed to be of a purely catalytic character, and to consist in the conversion of the hydrocarbon from its primitive or normal state of existence into one of its possible isomeric modifications. In this altered form the hydrogen and carbon constituents have re-arranged themselves in accordance with the formula*—

$$2H_{2(m-1)}C_{2(m-1)}\,;\,H_2 \sim 2C_2\,;\,H_2,$$

which implies that 2 molecules of hydrogen have become detached and typically changed into acid hydrogen nuclei, and, further, that one of these nuclei has re-united as principal with the rest of the hydrocarbon, which, relatively to that principal, is now destined to play the part of an adjunct, while the other, by appropriating 2 carbon molecules from the said adjunct, has given rise to a formen-holding hydrogen nucleus, $2C_2\,;H_2$, where the hydrogen and carbon are likewise destined to discharge the relative functions of principal and adjunct. Thanks to their freshly-acquired dissimilar electro-polar energies, these two differently modified hydrogen nuclei are now in a fit and proper condition for chemically combining with each other so as to produce the aforesaid complex molecule, whose first hydrocarbon adjunct is therefore composed of an olefine differing by $2H_2C_2$ from the parent hydrocarbon, while the second adjunct consists invariably of a molecule of formen.

It is here necessary for me to inform the reader that, by

* The reader will bear in mind that the various marks of punctuation used in my formulæ are typical symbols of molecular grouping. Thus, a dot connects the base with its acid; a semicolon connects the hydrocarbon adjunct with its principal; an inverted semicolon connects the halogen adjunct (which includes every species of mono- or polynormal acids, bases, or salts) with its principal; and a colon connects two or more simple hydrocarbons with one another. Observe, also, that in my rational formulæ the non-essential constituents are generally separated from the essential constituents by a horizontal line, and that the empirical formulæ used in my system are exactly the double of the ordinary formulæ: H = 2, C = 12, N = 14, O = 16.

my fundamental law of meta-chemical order of grouping, which presides over the collocation of the component groups of the molecules, the olefine-holding hydrogen nucleus stands lower in that order than the formen-holding hydrogen nucleus. Moreover, while both these hydrogen nuclei are held to play relatively to each other the part of co-ordinate principals, the former, from being more electro-positive, is understood to occupy in the system an inferior and more central position, in consequence whereof the first of these differently modified hydrogen nuclei is predestined to furnish the stronger, because more electro-positive, ether base, which, by the law of elective affinity, in the sense I take it, is predisposed to take possession of the stronger, because more electro-negative, acid.

In order to express these hitherto obscure and undefined relations in technical language, I shall retain the term "principal" for the lower-ranking hydrogen nucleus, and apply the term "ally," to the higher-ranking hydrogen nucleus, allowing a further distinction between the first, second, third, &c., ally in all those cases where, as I shall presently show, the continued action of oxygen on the first hydrocarbon adjunct tends to the formation of two, three, or more formylic ether molecules.

From the preceding remarks the reader cannot fail to perceive that, so far as it goes, my theory of the chemical constitution of the olefine-begotten polyatomic alcohols is not only exceedingly plain and transparent, but that it is susceptible likewise of a high degree of expansion and development. This theory is based upon an original conception, which, in its widest acceptation, may be briefly enunciated as follows:—"So long as a given hydrocarbon preserves its primitive or normal form of molecular arrangement, and which is characterised amongst others by the typical identity in the mode of aggregation of its more or less condensed hydrogen and carbon constituents, the whole system may be said to exist potentially in a state of chemical passivity, whereas, after merging into one of its possible isomeric modifications—that is, when a certain number of its component hydrogen or carbon molecules have assumed the acid-nucleus form of arrangement—this now typically altered system may be said to exist potentially in a state of chemical activity, because it has now acquired the faculty of entering into direct chemical union with oxygen and other metallic or non-metallic elements, for which these acid nuclei present in their respective envelopes a firm and solid point of attachment."

In obedience to this all-important law, the first and immediate product of the direct union of oxygen with a given olefine will be the biatomic ether molecule—

$$2H_{2(m-1)}C_{2(m-1)}\,;\,H_2O_2\sim 2C_2\,;\,H_2O_2,$$

which, in the presence of water, will speedily combine with 2 molecules of that element, with production of the biatomic alcohol—

$$\overline{2H_{2(m-1)}C_{2(m-1)}\,;\,H_2O_2\sim 2C_2\,;\,H_2O_2}.$$

Accordingly, this latter formula may be taken to express the chemical constitution of the "glycols," among which ethylen-glycol—

$$2H_2C_2\,;\,H_2O_2\sim 2C_2\,;\,H_2O_2$$

stands first in the series.

Let us, in the next place, contemplate the molecular changes which accompany the continued action of oxygen on the end-product of the preceding metamorphosis. These changes I believe to consist in the further abstraction of 2 molecules of hydrogen from the olefine adjunct, and their conversion into 2 molecules of water. At this point, two alternatives present themselves for consideration. These water molecules may either be set at liberty, or, by appropriating a molecule of formen from the olefine rest, they may become re-employed in the construction of a triatomic alcohol, which will then be composed of one olefine-holding principal and two formen-holding allies. Obviously the former alternative, which exercises no modifying influence over the biatomic character of the new compound, ought to give rise to the molecule—

$$\overline{2H_{2(m-2)}C_{2(m-1)}\,;\,H_2O_2\sim 2C_2\,;\,H_2O_2},$$

while the latter alternative, which imparts triatomic properties to the new compound, ought to give rise to the molecule—

$$\overline{2H_{2(m-2)}C_{2(m-2)}\,;\,H_2O_2}\quad\overline{2C_2\,;\,H_2O_2\sim 2C_2\,;\,H_2O_2}.$$

Accordingly, the first formula may be taken to express the chemical constitution of the "deglycols," among which deethylen-glycol—

$$\overline{2C_2\,;\,H_2O_2\sim 2C_2\,;\,H_2O_2}$$

stands first in the series, while the second formula may be taken to express the chemical constitution of the "glycerols," among which propylen-glycerol (glycerin)—

$$\overline{2H_2C_2\,;\,H_2O_2\sim 2C_2\,;\,H_2O_2\sim 2C_2\,;\,H_2O_2},$$

stands first in the series.

Let us once more contemplate the molecular changes which accompany the continued action of oxygen on the end-product of the preceding metamorphosis. It is clear that this action ought to give birth, on the one hand to a dehydrogenated triatomic alcohol—

$$\overline{2H_{2(m-3)}C_{2(m-2)}\,;\,H_2O_2\sim 2C_2\,;\,H_2O_2\sim 2C_2\,;\,H_2O_2},$$

and on the other hand to a tetratomic alcohol—

$$\overline{2H_{2(m-3)}C_{2(m-3)}\,;\,H_2O_2\sim 2C_2\,;\,H_2O_2\sim 2C_2\,;\,H_2O_2\sim 2C_2\,;\,H_2O_2},$$

which will be composed of one olefine-holding principal and three formen-holding allies. Accordingly, the first formula may be taken to express the chemical constitution of the "deglycerols," among which depropylen-glycerol—

$$\overline{2C_2\,;\,H_2O_2\sim 2C_2\,;\,H_2O_2\sim 2C_2\,;\,H_2O_2},$$

stands first in the series; while the second formula may be taken to express the chemical constitution of the "erythrols," among which butylen-erythrol—

$$\overline{2H_2C_2\,;\,H_2O_2\sim 2C_2\,;\,H_2O_2\sim 2C_2\,;\,H_2O_2\sim 2C_2\,;\,H_2O_2},$$

stands first in the series.

It is of importance to point out that my peculiar mode of reasoning, which it is needless to pursue any farther, has actually brought us face to face with the identical alcohol which, as already observed, claims to be regarded as the true progenitor of the three organic acids that form the subject of this paper. Having, therefore, adopted the last-mentioned formula as a safe and trustworthy basis of reasoning, I have founded thereon what seems to be a perfectly rational, harmonious, and comprehensive theory, concerning which I make bold to affirm that it brings to light the true genetic relations and molecular architecture of that almost overwhelming mass of substitution-products and derivatives, among which our triad of acid heterologues has long been conspicuous as the starting-point for an extensive series of highly interesting and instructive experiments.

It was stated above, as one of two possible alternatives, that, under the stimulus of oxygen, the olefine-begotten polyatomic alcohols are disposed to surrender to that element two of their constituent hydrogen molecules, which are immediately eliminated in the form of water. Now I have good grounds for believing that the residual

de-alcohols, as I will shortly call this class of compounds, are very prone to merge into an isomeric modification, where they become endowed with the same feebly acid properties, together with the power of precipitating silver from its salts, which characterise the aldehyds of the mono-atomic system. According to this view, the butylen-erythrol becomes first of all converted into the debutylen-erythrol—

$$\overline{2C_2 ; H_2O_2 \sim 2C_2 ; H_2O_2 \sim 2C_2 ; H_2O_2 \sim 2C_2 ; H_2O_2},$$

which, by the conversion of the third formylic alcohol ally into the isomeric formite of water, soon changes into the aldehyd-like butylen-erythrite—

$$\overline{2C_2 ; H_2O_2 \sim 2C_2 ; H_2O_2 \sim 2C_2 ; H_2O_2 : 2H ; 2C_2O},$$

and thence, by the absorption of 2 molecules of oxygen, into the butylen-erythrate of water—

$$\overline{2C_2 ; H_2O_2 \sim 2C_2 ; H_2O_2 \sim 2C_2 ; H_2O_2 : 2H ; 2C_2O_3}.$$

In the next stage, the monobasic butylen-erythrate is made to merge into the isomeric modification of the bibasic butylen-meta-erythrite*—

$$\overline{2C_2 ; H_2O_2 \sim 2C_2 ; H_2O_2 : 2H ; 2C_2O \sim 2H ; 2C_2O_3},$$

the metamorphosis being accomplished by the second formen-holding ally of the colligated depropylen-glycerol changing into the isomeric formite of water, the formous acid constituent of which is now made to play the part of *principal*, while the formic acid constituent exchanges its function of principal for that of *ally*. In the last stage, the meta-erythrite resolves itself into 2 molecules of water, and the meta-erythrous anhydride—

$$\overline{2C_2 ; H_2O_2 \sim 2C_2 ; H_2O_2 : 2H ; 2C_2O_2 \sim 2H ; 2C_2O_2},$$

which, by the method of orthogenesis (Part II., c. i., 3), becomes finally transformed into ortho-erythrite, or ordinary succinate of water—

$$\overline{2C_2 ; H_2O_2 \sim 2C_2 ; H_2O_2 : 2C_2O \sim 2C_2O}.$$

The reader cannot fail to perceive that, in order to explain the natural production of the malate and tartrate, it is only necessary to suppose that the meta-erythrite of water has become further oxidised, first into the meta-erythreite—

$$\overline{2C_2 ; H_2O_2 \sim 2C_2 ; H_2O_2 : 2H ; 2C_2O_3 \sim 2H ; 2C_2O_3},$$

and subsequently into the meta-erythrate—

$$\overline{2C_2 ; H_2O_2 \sim 2C_2 ; H_2O_2 : 2H ; 2C_2O_3 \sim 2H ; 2C_2O_5},$$

and that these compounds have then experienced a series of molecular changes precisely similar to those I have just shown to accompany the conversion of the meta-erythrite into the ordinary succinate.

In glancing at the formula of this latter compound, we might be led to imagine that it belongs to the class of readily-oxidisable aldehyds, and consequently that it should be possible to obtain therefrom, by direct oxidation, the ortho-malate and ortho-tartrate, which, by their respective formulæ—

$$\overline{2C_2 ; H_2O_2 \sim 2C_2 ; H_2O_2 : 2C_2O \sim 2C_2O_3}$$

and—

$$\overline{2C_2 ; H_2O_2 \sim 2C_2 ; H_2O_2 : 2C_2O_3 \sim 2C_2O_3},$$

are at once recognised as the two nearest upper heterologues of the succinate, these formulæ being at the same time well adapted to illustrate the all-important law that the oxidation always progresses from right to left, in the present instance from the side of the oxalous acid ally towards the side of the oxalous acid principal. Yet, strange to say, all attempts to oxidise the succinate by direct methods have invariably proved a failure.

In pondering the probable cause of this discrepancy, I could not help being struck with the scarcely fortuitous circumstance that in my system the true aldehyds are all constructed on the formyl type, with an uneven hydrocarbon for their adjunct, whereas the succinate and its homologues are all constructed on the oxalyl type, with a mono-or poly-atomic de-alcohol for their adjunct. Now, it is perfectly conceivable that these typical differences are of a nature to exercise a certain modifying influence upon the intensity of attractive force, which the carbon nuclei of these two kinds of acids are capable of concentrating upon a contiguous molecule of oxygen. But, while I shall be glad to learn that within the precincts of one of our laboratories this problem of direct oxidation has at length received a practical and commercially-profitable solution, I am strongly impressed with the notion that in the living organism this metamorphosis is accomplished by a different and presumably far more feasible method.

This method I hold to consist in the previous conversion of the ortho-succinate into the isomeric modification of the meta-succinate—

$$\begin{array}{ll} \alpha) & \overline{2(C_2 : C_2) ; H_2O_2 : 2H ; 2C_2O \sim 2H ; 2C_2O_3}, \\ \beta) & \overline{2C_4}; \end{array}$$

which, on the hypothesis that its complex carbon adjunct is capable of assuming two typically-distinct forms of grouping, is here represented as occurring in an α and β variety.

According to my view, the two acid constituents being now moulded on the formyl type, become thereby capacitated to impart to the meta-succinate the chemical character and properties of a true aldehyd, which, by the accession of one pair of oxygen molecules to the formous acid principal will give rise to the meta-malate, and, by the accession of a second pair of oxygen molecules to the formic acid ally, will give rise to the meta-tartrate, whence the ortho-malate and ortho-tartrate will then be finally produced by the method of orthogenesis, for which the reader has already been referred to the second part of this paper.

Having now briefly delineated the main features of those natural processes, whereby the three acid heterologues of the erythric family group are supposed to be engendered in the interior of plants and vegetables, I shall proceed to the second part of my programme, for which I have reserved the disclosure of a new set of molecular relations and modes of grouping, the theoretical importance of which can scarcely be over-estimated.

(To be continued.)

* Let it be borne in mind that, in my theory, all those organic combinations are understood to belong to the class of polybasic meta water-salts, which, besides containing for their halogen adjunct a mono- or poly-atomic de-alcohol, include among their acid constituents two molecules at the least that are moulded on the formyl type. Again, all those organic combinations are understood to belong to the class of polybasic ortho water-salts, which, besides containing for their halogen adjunct a mono- or poly-atomic de-alcohol, include among their acid constituents not a single molecule, or, at the most, one only, that is moulded on the formyl type, while the rest are all moulded on the oxalyl type.

CALORIMETRIC PYROMETER FOR THE DETERMINATION OF HIGH TEMPERATURES.

THE problem of the determination of temperatures higher than that of the boiling-point of mercury has not been solved in a satisfactory manner. M. J. Salleron describes in *Les Mondes** an instrument which, founded on the principle of the calorimeter, he thinks unites the best approximative conditions with practical simplicity. The instrument consists of a cylindrical vase of red copper open at its upper end, and surrounded by an outer

* Vol. xxvi., No. 13

envelope of brass. The red copper vase is supported in this outer vessel by means of an annular disc of wood. A layer of air thus separates the two vessels, and this arrangement has for its end the diminishing of the loss of heat by radiation and also by conduction. For the same reason, the mouth of the vase is closed by a wooden cover pierced with an opening. By this opening, there are introduced into the calorimeter determined weights of water, and a heated mass of red copper. This piece of copper (in the shape of a bolt) rests on an arm passing through the wooden cover, and the arm is susceptible of such movement as will enable the operator to agitate, and with the hot copper bolt equally heat, the liquid in the vase. The heat of the liquid is determined by means of a thermometer.

To use the apparatus, half a litre of water is measured into the copper vase, and its initial temperature, t, noted by means of the thermometer. The cylinder of red copper (which weighs 106 grms.) is placed in the furnace of which it is desired to ascertain the temperature, T, and, when heated, is rapidly immersed in the water of the calorimeter. The water is agitated until equally heated; and, during this time, the mercury of the thermometer first rises rapidly, then more slowly, and finally becomes for a few instants stationary before it commences to fall. The final maximum temperature, t', is noted, and the temperature, T, found by the formula $T=50(t'-t)+t$. Thus, if before the immersion of the copper cylinder the temperature were 15°, and afterwards 25°, the temperature of the heating source would approximate—

$$[50(25-15)+25=525].$$

Platinum may be substituted for copper for temperatures above 1000°.

The method supposes that, at the instant of its immersion, the copper or platinum cylinder possesses exactly the temperature to be measured. To realise this condition, it is necessary to take precaution against loss of heat during its transport to the calorimeter. With this view, M. Salleron introduces the copper cylinder into an iron tube, provided at one extremity with a wooden handle, and at the other with an opening only sufficiently large to admit of the passage of the cylinder. This opening is excentric with relation to the axis of the tube, so that the weight introduced into the tube is maintained there when the tube is held in one direction, and will fall out when the tube is turned half round in the other direction. A copper cylinder is introduced into the tube, and this into the source of heat until the copper is raised to a temperature uniform with the source of heat, when the tube is removed, quickly carried to the calorimeter, and, by a half-turn, the copper cylinder is thrown into the water. The heat of the iron tube practically prevents radiation from the copper cylinder.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from p. 69).

To return, then, to Kater's experiments. He had first to determine a pendulum which should vibrate seconds in the latitude of London. He did it in the house of Mr. Brown, in Portland Place, which house has an astronomical bearing from Portland Chapel of 74 deg. 38 min. 50 sec. west from north, the distance being 283 feet, and therefore the house is about half-way up Portland Place on the left-hand side. In that house the pendulum was first adjusted. Nothing seems easier than to deal with a simple vibrating ball on a string. It is not, however, so easy as it seems. It can not be made to swing in the same plane as this one now appears to do. If left free to choose its plane of vibration it is seldom contented. It will not have a dozen swings in the same plane; it must, therefore, somehow or other, be made rigid, and so prevented from such vagaries. Here is a small vessel of lead, hanging by a bundle of untwisted fibres from a hook, and you might think nothing could be easier than to let it swing backwards and forwards on the same path, bur it will not swing for two minutes in the same path; hence, pendulums are all compelled to act in restrained paths, and generally supported on knife edges. French clocks have two strings of silk to the pendulum. These are fastened to two hooks at the top, and the pendulum rod being hung from the junction of the two silken cords, it is constrained to describe a path in a plane at right angles to that in which are the silk threads.

To return to the leaden vessel. It is now filled with fine white sand, and at the bottom there is an opening out of which the sand can trickle whilst the vessel swings freely. The figure caused by the sand falling on a board beneath will show the path that the vibrating body describes. It shall now be let go in what appears to be a straight line. If you watch that path you will see it is a very curious one. The sand at once indicates that the ends of the line are travelling round, also that the line itself is becoming wide in the middle. In fact a straight line is seldom formed by the falling sand from such pendulums. Even if a circular path be commenced, you will find it cannot be retained. It reminds one very much of one of the secular astronomical changes, that is, our year of 365 days and a fraction results from this gradual advance of the perihelion path of the orbit of the earth; observe it tends first to a straight line, then through an ellipse to a circle, and then a return action commences, and it will repeat this process from the straight line opening out again, and so pass on through various phases, until it comes to rest, Hence a pendulum constructed of a simple form is of no value, and yet it is in its simple form we require it. It was needful to assume for the purpose of the calculation that we can make a pendulum do that which this swinging vessel of sand is not doing.

Captain Kater was the first to deal with the case of converting the compound pendulum into a simple one. A pendulum is said to be a simple one when it consists of a heavy particle at the end of a very light thread. Such is almost an imaginary pendulum. All pendulums that we see are compound ones. Now, by pursuing the plan adopted by Captain Kater, he was able to obtain from the compound pendulum what would be the length of an equivalent simple pendulum. His pendulum has two pairs of knife-edges, a pair at the upper end, on which it swings, and a pair at the lower end. He placed one pair of these knife-edges on a smooth, hard surface, so that the pendulum might vibrate without anything causing it to continue its vibrations except the force of gravity. Now, if you look to this diagram, you will see the motions of a compound pendulum. If it were short it would move thus, and if it were longer it would move more slowly. The black dots in the diagram represent the lower ends of pendulums of different lengths. Assume that the black dots are the ends of separate pendulums, one behind the other, from the same support, they will then occupy those places after the same interval of time from rest; if, however, these pendulums are united, then the one is kept back by the action of the other; now they are really united in a compound pendulum. There is, however, some point or other at which, if all these masses were concentrated, the velocity at that point would be the velocity of the mass, therefore such a pendulum would vibrate in the same time, and it would be called a simple pendulum. Kater found that this collected point, which is called the centre of oscillation, and this at which the pendulum is suspended, are interchange-

* The Cantor Lectures, delivered before the Society of Arts.

able; in fact, he found that if the pendulum was accurately adjusted by means of these movable weights, he could suspend it upon a pair of the knife-edges, and he could get a certain number of vibrations in a minute or a second. Then, if he turned it upside down, assuming the pendulum to be right, and caused it to swing as before, upon the other pair of knife edges, it would make the same number of vibrations. Those two points he marked, and the distance between them is the length of an equivalent simple pendulum. With such a compound pendulum as now described, and of which the one before you is a copy, counting the number of vibrations it makes, you can always deduce the length of a simple pendulum that would make the same number of vibrations.

What Kater did, then, was this—he had a clock kept going, strictly to truth, that is, to true astronomical time. The clock was furnished with a gridiron pendulum of the construction shown in the diagram, and so carefully arranged as not to be altered in length in consequence of change of temperature. On the bob of the pendulum, in front, was a white speck, as on the pendulum bob of this clock. He placed the compound gravity pendulum, which has been described, in front of the clock, the clock pendulum beating 86,400 strokes per mean solar day. The rate of the clock was determined by astronomical observations, and therefore, on any part of the earth's surface, it would be possible to so arrange the solar pendulum that the clock should always record 86,400 beats in a mean solar day.

Now let us turn to this two-ended pendulum of Capt. Kater. It is of an invariable length, and acted upon directly by the force of gravity; there are no weights or clockwork in connection with it. When it is up on one side, it is the power of gravity that causes it to fall, and it is gravity which keeps it going. If, for example, a powerful magnet be placed under that pendulum, then it will come to rest sooner than it would otherwise do, because it is pulled down with greater force. If, therefore, gravity changes in its pull on this pendulum, it will tell on the rate of its vibrations. The rate of vibration of the equivalent simple pendulum is known, because it has been calculated from this compound one; hence, if this compound pendulum be placed in front of the clock keeping astronomical time, and if the vibrations of the pendulum be counted whilst the vibrations of the clock pendulum are being recorded, it might be ascertained whether the force of gravity varied in different places.

The means by which Kater compared these vibrations are very simple. You see the white speck, previously referred to, on the bob of this gridiron pendulum. He took a telescope, and placed it at some distance on a level with that white speck. Between the white speck and the telescope, and near to the gridiron pendulum, swung the gravity pendulum, which moved slower than the other, being made a little longer. Keeping his eye upon the telescope, and directed upon a narrow piece at the end of the gravity pendulum, which was the same width as the white circular speck upon the bob of the clock pendulum, he could tell when the two coincided. As one pendulum swung slower than the other, it was quite clear that a coincidence must take place, and he noted the time of the coincidence. That was the beginning of counting vibrations, and he then waited until they separated, and until the coincidence again took place a second time, which gave the number of the vibrations in a given time as recorded by the clock. Experiments like these were repeated very frequently and carefully, until at length the average was obtained as to the number of vibrations that this gravity pendulum made, compared with the vibration that the one on this mean solar clock made. Within the tube of this telescope there are crossings of very fine wires —so fine as to be hardly visible to unaided vision; the threads of a spider's web were formerly used for this purpose. A spider is taken in the fingers; then, if shaken, he would run his web out to save himself, and this web was placed in the focus of the eye-piece, and the threads were so that the crossing of them was in the axial line of the telescope. It was by looking along that axial line that the time was observed when the coincidence of these two pendulum marks took place. The accuracy with which that was done is more easily to be imagined than realised.

Assuming that this has been accomplished, let us look for a moment to other elements which would disturb the result. In the first place, the pendulum vibrated in air; and you were told, in the first lecture, that a body weighed in air and weighed in any other medium is not balanced by the same weight. Hence, the effect of the air upon the pendulum has to be considered. Then the pendulum is vibrating in a changing atmosphere, sometimes warm, sometimes cold, and a change of the temperature causes an expansion or contraction, hence the effect of that expansion was to be considered. And, simple as it seems, to estimate whether a pendulum is longer or shorter is really very difficult. Indeed, great was Captain Kater's perplexity about it.

He measured the length of his pendulum thus:—He formed a box similar to the one on the table, and laid his pendulum in it, and applied a microscope over one of each pair of opposite knife-edges, placing behind them a piece of white paper, so that the edge might be seen. He then applied the microscope. Again, he put beneath them a piece of black paper, and he found that the measurement with the white paper was never the same as the measurement with the black paper. After describing how with microscopes he attempted to measure between knife-edge and knife-edge, by placing them when white on a black ground, and when black on a white ground, he adds:—"In one case, the knife-edges seemed to start forward to each other." This difficulty is summed up thus:—"On the cause of this extraordinary fact I can hazard no conjecture, and it remains an interesting subject for future investigation."

We now know that this resulted from a phenomenon called "irradiation." Hence he was bound, even in looking through those microscopes to strike an average of the apparent errors.

Another error that occurred, which he also found great difficulty in remedying, and indeed never did remedy, so that in fact the experiments he made are liable to some infinitesimal corrections still, was this:—If a pendulum vibrates, as this one was doing just now, the air clings to it, and is carried along with it, from what is called the "viscosity" of the air. That viscosity is such that, if you were to put a short piece of gold-leaf projecting edgeways upon the face of the pendulum bob, you would find that the gold-leaf moved with the action of the pendulum, and was carried along with it, so that it turned neither to one side nor the other. If, however, the gold-leaf projected beyond a certain distance, then you would find it bend with the air. Therefore, the atmosphere in immediate contact with the bob was dragged along with the pendulum, and that particular element Captain Kater was not aware of. Government, some years ago, in order to set this question at rest, had large vacuum chambers erected, and pendulums set vibrating in them, to ascertain how great an error was caused by the viscosity of the air.

Captain Kater having determined the length of this pendulum in the latitude of London in 1818, it was thought of great consequence to ascertain how far the force of gravity varied in different latitudes.

A memorial was presented to the Government in 1818, in order to ascertain by means of a pendulum how gravity varied throughout the British Isles, and Kater was commissioned to take steps for the purpose. Government placed at his disposal certain members of the Royal Corps of Engineers, with whom he set out to the north of Scotland, and made experiments at various places. He went up to Unst, in the Shetland Isles, then he came down to Portsoy, then to Leith, then down to Clifton, in Yorkshire, then to

Ashbury, then to London, and then to the Isle of Wight, and in each of those places he made certain experiments based upon the principles now too briefly described. This lecture would extend far beyond the allotted time if it entered into details with reference to local arrangements and special calculations. It may suffice to refer to the table for particulars of the results. The following is a copy of the table:—

Name of Place.	Latitude of Place. Deg. Min. Sec.	Vibrations in a Mean Solar Day.	Length of a Pendulum to Vibrate Seconds.
Unst	60 45 28·20	86,096·90	39·17146
Portsoy ..	57 40 58·65	86,086·05	39·16159
Leith Fort ..	55 58 40 80	86,079·40	39·15554
Clifton	53 27 43·12	86,068·90	39·14600
Ashbury Hill	52 12 55·32	86,065·05	39·14250
London ..	51 31 8·40	86,061·52	39·13829
Shanklin, or rather Dunmore	50 37 23·94	86,058·07	39·13614

From this table it will be seen that the length of a pendulum vibrating seconds in the places respectively entered is that given in the last column.

These lengths are sufficient to enable a mathematician to calculate the force by which the pendulum is caused to swing. Now, as the only force causing this swing is that of gravity, such a calculation determines the force of gravity at that place in relation to its power to produce motion. Hence is deduced those 39 inches, which, in ordinary expression, is thus broadly stated to be the length for pendulums vibrating seconds in the latitude of London. Captain Kater deduced that 39·13829 inches was the length of a pendulum vibrating seconds in Mr. Brown's house in London. This length requires to be reduced to sea-level. Now, the rooms of the Royal Society, at Somerset House, are 81 feet above low-water, and by the aid of a mountain barometer, made by Ramsden, Kater found the room in Portland Place to be 2 feet below those of the Royal Society, and, as the length of pendulum above the floor was 4 feet, the elevation of pendulum above sea-level is 83 feet.* Now, gravity varies inversely as the square of the distance of the place from the centre of the earth; therefore, the length of pendulum must be increased in this proportion; and, taking the radius of the earth for the latitude of Portland Place to be 3954·583 miles, we have 39·1386 inches for pendulum vibrating seconds at the level of the sea in the latitude of London.

The greatest difference between the mean and that of any of the sets of experiments is only 0·00028 of an inch, or $\frac{1}{1341\frac{1}{3}\frac{1}{3}}$ of length of pendulum. The length 39·1386, as thus determined, is that required to perform one vibration, in $\frac{1}{86\frac{1}{400}}$ of a mean *solar* day, under the circumstances described, and at the level of the sea.

Finding how much could be obtained from this with regard to the British Isles, Government commissioned Captain Sabine to go to different places on the east coast of Africa, the Island of Ascension, Bahia, Trinidad, Jamaica, New York, Greenland, and Hammersfest, in Norway, and repeat Captain Kater's experiments. These experiments are repeated, and then, by an arithmetical process which need not be referred to in detail, it was very easy, having given the number of vibrations of this invariable pendulum (for the distance between these knife-edges did not vary) performed in a solar day, to calculate the power that was pulling it; and from that calculated power could be obtained the mass of the earth beneath the place where it was being pulled, making, of course, all the allowances for corrections and other circumstances. That calculated power gives the 32 feet which we are all acquainted with as the measurement of gravity. The meaning of which is, that gravity will generate in a 1-lb. weight, in one second, a velocity thirty-two times greater than that which it is agreed shall be called the unit or absolute measure of force. Put conversely, the absolute unit of force is equal to the weight of 16 ozs.

$\frac{16}{32\cdot2} = \frac{1}{2}$ oz. nearly.

Captain Foster afterwards repeated these experiments, and made others, and from them has been obtained the figure of the earth, and calculations of all kinds used in scientific investigations throughout the globe depend upon them. Captain Foster was unfortunately drowned in the river whilst observing some of his experiments, but Mr. Baily undertook to tabulate his results, and completed the calculations on the data which had been obtained by Captain Foster's observations. The calculations Mr. Baily made for this purpose occupy many closely-printed quarto pages of figures. The result was solely to ascertain the length of the pendulum, and so deduce the figure of the earth. Great beyond all ordinary estimate is the amount of care, patience, perseverance, and anxiety that attends experiments of this kind.

(To be continued).

* The reason to conclude that the measurement requires to be corrected.—A. R.

NOTICES OF BOOKS.

Plattner's Manual of Qualitative and Quantitative Analysis with the Blowpipe. From the last German edition, revised and enlarged. By Prof. Th. Richter, of the Royal Saxon Mining Academy. Translated by Henry B. Cornwall, A.M., Assistant in the Columbia College School of Mines, New York, and John H. Caswell. Second Edition, revised. New York: D. Van Nostrand.

It would be utterly superfluous on our part to express any opinion on a work which has won so high a reputation as the great masterpiece of the late illustrious Professor of Freyberg. The present version is founded on the latest German edition, enriched with the valuable additions of Professor Richter. Among the improvements we notice the introduction of no fewer than 150 new minerals, a quantitative test for mercury, the description of new apparatus for measuring silver assay buttons; and an elaborate index in three divisions—one for minerals, another for metallurgical products, and the third general. The instructions for the quantitative determination of bismuth, cobalt, nickel, iron, and for the examination of coal, have also been added since the appearance of the former English translation from the pen of the late Dr. Sheridan Muspratt. The reader will be enabled to compare the two versions when we state that Dr. Muspratt's has only 392 pages exclusive of index, while Mr. Cornwall's extends to 522, and is more compactly printed. The editor appears to have carefully and conscientiously discharged his duties. The retention of the old Berzelian formulæ, in which oxygen is expressed by dots, and sulphur by commas placed above the symbols of the other elements, may seem strange to some readers, but it is not without advantages in mineralogical matters. We cannot in passing refrain from protesting against an expression which has caught our attention. To be told that—"copper occurs *quite* extensively in nature," grates on the ears of all who have been accustomed to precision of thought and language. As the latest and best English version of Plattner this book will be indispensable to all students of mineral chemistry and its applications.

Observations on the Agricultural Chemistry of the Sugar-Cane. By T. L. Phipson, Ph.D., F.C.S. London: Ranken and Co.

What may be called the stereotyped orthodoxy of agricultural chemistry receives from time to time very severe shocks. But a few years ago we were taught that the sole duty of the chemical manure maker was to offer his customers abundance of phosphoric acid in a soluble form, and of nitrogen—though the importance of the latter was

not universally conceded. *Now* we learn alike from scientific research and from practical experience that a plot of land may become exhausted of other constituents as well as of phosphates and combined nitrogen, and that in such cases superphosphates and ammoniacal salts are useless. This truth is ably enforced by Dr. Phipson, not merely as regards the sugar-cane, but for crops in general. He points out that the substances added to a soil must not only be sufficient in quantity and right in kind, but must also be in an assimilable condition if the plants are to be benefitted. Liebig showed that by burning a plant to ashes, and analysing the result, we learn the food necessary to render it luxuriant in a given soil. But if we burn a quantity of wheat-plants to ashes, and apply this residue as manure to a fresh plot of land sown with wheat, the crop proves a failure. The author states—"The burning of a vegetable to procure the ash renders the mineral food it naturally contains almost useless as manure." On superphosphate employed as a sugar-cane manure he places little reliance. Ammoniacal salts have been largely tried in Demerara; the result being the rapid growth of the canes, and the production of a juice poor in sugar. A very important fact to which the author calls attention is that the analyses of the mineral ingredients of plants, incinerated after they arrive at maturity, must coincide, and "can alone teach us accurately what any plant takes from the soil." Dr. Phipson was once called to report upon a number of analyses of sugar-cane, executed by chemists of admitted skill, but which nevertheless presented serious discrepancies. After a long investigation he found that the samples of cane had been taken at various stages of growth, and the results consequently could not coincide. On the other hand, an analysis of some ripe coffee berries from Ceylon coincided most closely with one made thirty years ago with West-Indian coffee. This is an apt illustration of the old, but not stale, truth that analyses of organic substances except made under distinctly defined circumstances are merely a waste of time. The author finds that the sugar-cane withdraws lime from the soil more rapidly than magnesia. Hence, "the degree of exhaustion which a cane soil has undergone can, to a great extent, be ascertained by comparing the relative amounts of lime and magnesia" found on analysis. The deficiency of humus—an article not long ago proclaimed of little value—is found in Java to be a source of sterility, "by causing a want of porosity, of nitrogen, and of carbonic acid." In this country every nurseryman and market gardener knows the importance of humus, however unable he may be to point out its exact mode of action. The most important portion of Dr. Phipson's pamphlet is where he shows the value of farmyard manure, night-soil, and similar residues as containing not merely "all that the plant requires," but also "*in the proper state for assimilation.*" This truth has of late been forcing itself, from various points of view, upon the attention of agricultural chemists. Manures made from excrementitious and sewage matters, though poor in the two fashionable items of phosphoric acid and ammonia, are yet found in practice to give better results than some which "analyse well." Dr. Phipson's pamphlet is, in short, highly suggestive, and whilst we cannot approve of all it contains—*e.g.*, the laudatory mention of certain firms in the manure trade—we have much pleasure in recommending it to our readers.

The Retrospect of Medicine. Edited by W. Braithwaite, M.D., and James Braithwaite, M.D. Vol. lxvii., Jan. to June, 1873. London: Simpkin, Marshall, and Co.

This volume, subdivided into sections on practical medicine, surgery, midwifery, &c., contains little matter directly connected with chemical science. We notice certain particulars on a recent outbreak of enteric fever at Nunney, in Somersetshire. The disease is distinctly shown to have been introduced by the evacuations of an individual attacked finding their way into a small stream which supplied the village with water. With the introduction of a supply of uncontaminated water the number of fresh cases fell, from eight to thirteen weekly, to five; and in the subsequent week to one. Dr. B. W. Richardson gives an account of his last new anæsthetic methylen ether, which he considers safer than chloroform or methylen bichloride, whilst possessing all their advantages. That vexed question—the therapeutic use of electricity—is also discussed at some length.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, July 21, 1873.

Third Notice on Guano.—M. Chevreul.—The author examines into the cause of the development of carbonic acid gas when the hard portions of the guano come in contact with water, and announces his intention of examining under what circumstances carbonate of ammonia behaves in this manner.

On Nitrification in Soils.—M. Th. Schlœsing.—The author finds that the quantity of nitric acid produced is not proportional to the amount of oxygen contained in the air, the relation between these two quantities—the amount of nitric acid produced, and the proportion of oxygen contained in the air, being very complicated. When the proportion of oxygen in the air does not exceed 1½ per cent, the amount of nitric acid produced is even then very considerable. The arable soils almost entirely separate the oxygen from the other gases present in the atmosphere. As the proportion of oxygen augments the yield of nitric acid is increased, and seems to attain its maximum when the oxygen is about 16 per cent; beyond which it decreases in proportion to the increase of the oxygen. These experiments seem to prove that the free nitrogen and oxygen of the air take a direct part in the formation of nitrates. The soil used by the author in his experiments was rich in humus and in lime. All carbonic acid and ammonia pre-existing in the atmospheres operated upon had been previously eliminated.

On a Compound of Picric Acid and Anhydrous Acetic Acid.—D. Tommasi and H. David.—The formula of the new compound is—

$$\left.\begin{matrix} C_6H_2(NO_2)_3 \\ C_2H_3O \end{matrix}\right\} O$$

It may be regarded as a picrate in which 1 atom of metal is replaced by acetyl. It melts between 75° and 76°, begins to decompose at 120°, turns brown at 180°, and is completely decomposed at 260°, leaving a carbonaceous residue. Alkaline solutions split it up in the cold into acetic and picric acids. It does not detonate on percussion, but if mixed with chlorate of potassa it explodes with violence.

Action of Pyrogallic Acid upon Iodic Acid.—M. Jacquemin.—Pyrogallic acid placed in contact with iodates turns brown instantly. The reaction is the same whether the iodic acid be free or combined. Bromic and chloric acids have no such action, except the latter is concentrated enough to ignite paper; whilst iodic acid acts energetically even when diluted with 250 parts of water. Hence, pyro-

gallic acid may serve as a reagent to indicate the presence of iodates occurring as impurities in a commercial sample of iodide of potassium.

On a Native Compound of Oxides of Iron and Copper, and on the Artificial Formation of Atakamite.—C. Friedel.—This new mineral—delafossite—is found at Katharinenburg, Perm, Russia, accompanying laminary graphite. Its composition is—

Sesquioxide of iron	47·99
Alumina	3·52
Suboxide of copper	47·45
	98·96

Its sp. gr. is 5·07; its hardness 2·5. It yields a greyish black powder, and is opaque even in the thinnest laminæ. Atakamite was artificially produced by heating a solution of ferric chloride with cuprous oxide to 250° for eighteen hours in a sealed tube. Brilliant green crystals were deposited on the sides of the tube, agreeing in form and properties with atakamite.

On Spontaneous Alterations in Eggs.—U. Gayon.—The author finds that the putrefaction of eggs is correlative with the multiplication of vibriones, and is not in all cases accelerated by shaking and mixing up the white and the yolk. Mouldiness may also set in—which is not to be confounded with putrefaction—and is caused not by bacteria or vibriones, but by vegetable spores. In another and rarer change the egg gives off a peculiar acid smell without putridity, having an acid reaction, and containing alcoholic products. In this case no bacterian germs are present.

Note Concerning the Change of Velocity of Regime in Isochronous Regulators.—M. Y. von Villarceau.—The author here discusses the case of a temporary change; as where, after observing stars with an equatorial, one wishes to observe a planet, a comet, &c., and it is desirable to be able to alter the instrument quickly. He mounts the axis of the regulator in a movable frame, so that one may give it any inclination to the vertical. He investigates the mode of action of an isochronous regulator with the axis inclined.

New Researches Confirming the Localisation in the Cerebellum of the Co-Ordinating Power of Movements Necessary to Walking, Standing, and Equilibration.—M. Bouilland.—The author has been led to this result by experiments on some thirty animals of different species, and by clinical observation. He doubts Flouren's doctrine that the cerebellum co-ordinates all the voluntary movements of translation and prehension. Further, in place of holding that the brain co-ordinates none of the voluntary movements of translation and prehension, he holds that it co-ordinates a great number of them, but not those of walking and standing.

Direct Demonstration of the Fundamental Principles of Thermo-Dynamics; Laws of Friction and Impact according to this Science.—Continued extract from memoir by M. Ledien.—The writer here establishes some formulæ, and gives some explanations relative to motion and velocity in a system of material points.

Movement of a Spherical Segment on an Inclined Plane.—Extract from memoir by Gen. Didion.

Spectra of Iron and some other Metals.—P. Secchi.—He wished to ascertain whether the line 1474 K, seen in the corona of eclipses really belonged to iron, as has been asserted. Fifty Bunsen couples were used, giving a powerful force. The voltaic arc of iron was got in various ways—(1) With two iron cones; (2) with one at the positive pole, and a carbon cone at the negative; (3) with drops of iron in a little hollow of a carbon point forming positive pole. He used a direct-vision spectroscope, and with a heliostat reflecting the sun's rays between the electric poles he could have the solar spectrum and that of the electric arc superposed. He examined carefully the lines in the superposed spectra, and also those in the iron spectra alone; also tried various kinds of iron, but in no case did the line in question appear; and he concludes, that if it belongs to iron, it is developed in circumstances of temperature still unknown. He makes some further remarks on the spectrum of the arc from the carbon points which, projected on a white screen with a Duboscq apparatus, had a size of about 10 centimetres, so that its different parts could be well examined separately. He notes some differences from what Morren and others have observed in the carbon vapour spectrum. Experimenting as to whether any other metals gave the finely fluted spectrum of carbon, he found that aluminium gave it admirably.

Permeability of the Sand at Fontainebleau.—M. Belgrand.

Experiments on the Movement of Swell Produced in an Artificial Channel, making the Water Rise on an Inclined Plane to a Height Sensibly Constant.—M. de Caligny.—The writer's design is to show the advantage, for study of waves, of isolating a phenomenon in an artificial channel. The experiments made were of a rough and preliminary character.

Letter from M. Nordenskiold, from Mossel Bay (lat. 79° 54', N.), where the Expedition passed the Winter.—Among other interesting facts it is stated that Lieut. Parent and Dr. Wykander had been studying the aurora and its spectrum with an excellent apparatus, and had determined seven different spectral lines; which Dr. Wykander thinks are exactly the spectrum of the lower part of the flame of a candle or of a petroleum lamp. This seems to indicate some relation between the aurora and the fall of cosmic dust containing carbon, hydrogen, metallic iron, along with snow (as described in a previous letter). It may explain anomalies observed in auroral spectra in different places and at different times. The vegetation of Algæ seems to attain a maximum in the darkness and cold of an Arctic winter. The botanist considers they can live without light, and at a temperature of −2° C. The photographer found that a sensitised plate kept twelve hours on the sea bottom, where Algæ were flourishing, underwent no change. In walking along near the coast one observes a bright luminous trace on the snow. This is produced by myriads of small crustacea at a temperature of −10° C.

On some Matters Suited for the Destruction of Phylloxera.—M. Petit.—These are coal-tar, ammoniacal water, and the lime from gas refineries.

New Spectral Observations which are in Discord with some Theories of Solar Spots.—M. Tacchini.—The author followed the progress of faculæ giving a metallic spectrum (and attesting eruption) throughout a whole semi-rotation, but found no spot appear. This, in his view, increases the difficulties of both P. Secchi's and M. Faye's theories. On the former theory every eruption should give a spot; and on the latter a metallic spectrum should only be observable in case of a cyclone, *i.e.*, a solar spot. The present observation proves the contrary. M. Tacchini further states that he had observed in a solar region an eruption extending over nearly 50° of latitude, and not terminating for seven days; during which time magnesium and Kirchhoff's line 1474 were always visible on the entire border of the sun. Here, then, is a general movement in the upper layers of the sun, independent of the movement of rotation.

Researches on Electrical Condensation.—M. Neyreneuf.—The following conclusions are arrived at:—(1) The constancy of charge of the ordinary electrophorus is due to imperfect contact; (2) The employment of a proof plane is quite defective for quantitative and even qualitative researches as to the electrisation of an insulating plate; (3) the employment of a gold-leaf electroscope requires great precaution, because of the variable state arising from the action of the insulating plate of a condenser as electrophorus; (4) an electrophorus placed

in the best theoretical conditions would hardly give any effect, because of the antagonism of spontaneous discharges, and those obtained by ordinary action of the apparatus.

Annalen der Chemie und Pharmacie, band clxviii., heft 1. (Neue Reihe, band xcii., heft 1.)

On Azophenylen.—Prof. A. Claus.—This substance, obtained by the dry distillation of the azobenzoate of lime, consists of—

Carbon	79·12
Hydrogen	5·49
Nitrogen	15·38
	99·99

and may be expressed by the formula $C_{12}H_8N_2$. It forms long, light yellow, shining needles, which melt at 170° to 171° and sublime unchanged at higher temperatures. It dissolves in about 50 parts of cold alcohol, but readily in the same liquid when hot. It is very sparingly soluble in water, and crystallises unchanged from these solvents. It is volatilised along with the vapour of boiling water, to which it gives a pleasant aromatic odour resembling that of the oil of cinnamon. In hydrochloric acid it dissolves unchanged and may be re-crystallised from the solution. Nitric acid converts it into a nitro product which separates out in brown, flocculent, crystalline masses. On prolonged heating with concentrated sulphuric acid it is converted into a sulpho acid. The author has formed and examined bromazophenylen, $C_{12}H_8N_2Br_2$, hydrazophenylen, $C_{12}H_{10}N_2$, and the combinations of the latter with sulphuric and hydrochloric acids, and with platinum. The paper concludes with a lengthy hypothetical dissertation.

On Di-Iodhyrin.—Prof. A. Claus.—Di-iodhydrin is a yale yellow thick oil, of the sp. gr. 2·4 at a temperature of 15°. At −16° to 20° it congeals to a colourless crystalline mass. Its formula is $C_3H_6I_2O$.

Action of Ammonia upon Dichlorhydrin.—Prof. A. Claus.—If dichlorhydrin is heated with alcoholic ammonia to 105° in a sealed tube, one of the products is an amorphous gelatinous body—chlorhydrinimid,—

$$C_{12}H_{27}N_3Cl_2O_4.$$

It is a white body, insoluble in water, alcohol, ether, and even in concentrated acids. If the alcoholic ammonia is very weak there are produced—instead of chlorhydrinimid—two new bases, diamidohydrin and glycidamin.

Preparation of Dichlorhdyrin.—Prof. A. Claus.—About 800 grms. of glycerine (concentrated till its boiling-point is 195°) are placed in a flask holding 2 litres, and 2 kilos. of chloride of sulphur are gradually added with constant stirring, whilst the whole is heated in a bath of common salt. The flask is fitted up with a cohobation tube, which is removed after the heat has been applied for 7 to 8 hours in order to drive off the sulphurous and hydrochloric acids. When the mass is cool 2 or 3 volumes of ether are added, the deposit of sulphur is filtered off, the ether is distilled off in the water-bath, and the residue submitted to distillation over the open fire. After thrice repeated rectification pure dichlorhydrin is obtained, boiling at 178°.

Applicability of the Periodic Law to the Metals of the Cerium Group.—D. Mendelejeff.—A controversial paper in reply to Rammelsberg. (See *Ber. d. Deut. Chem. Gesells.*, 6, 84.)

Preparation of Ethylen and Ethylen-Bromide.—E. Erlenmeyer and H. Bunt.—This paper would not be intelligible without the accompanying diagram.

Action of Nascent Hydrogen upon the Oil of Bitter Almonds.—Hugo Ammann.—The author examines hydrobenzoin and its behaviour with chloracetyl and chloride of phosphorus; also isohydrobenzoin, which, as well as hydrobenzoin, is formed by the action of sodium amalgam upon the oil of bitter almonds, and its behaviour with the same reagents.

On Bromised Benzol Sulpho Acids.—Adolph Woel.—This paper gives an account of dibrombenzol-sulphacid, and its barium, calcium, potassium, ammonium, copper, and lead salts; its behaviour with melting hydrate of potassa; experiments on the preparttion of benzol-tricyanide and benzol-tricarbonic acid; monobrombenzol-sulphacid and its transformation into benzol-dicarbonic acid.

Investigations on the Constitution of Piperin, and its "Splitting up" Products, Piperic Acid, and Piperidin.—Rud. Fittig and Ira Remsen.—This paper treats of the synthesis of piperonylic acid, and of a new mode of formation of protocatechuic acid aldehyd.

On Ethylen-Protocatechuic Acid.—Rud. Fittig and Thomas Macalpine.—The formula of this acid was ascertained to be $C_9H_8O_4$. The authors examine its calcium, barium, and sodium salts; its ethylic ether; its decomposition when heated with dilute hydrochloric acid; its behaviour with chloride of phosphorus, dichlorethylen-protocatechuic acid being the result; its preparation from carbo-hydrochinonic acid, which latter the authors consider completely identical with protocatechuic acid.

Some New Compounds of the Naphthalin Group. J. P. Battershall.—The author's object was to find in the naphthalin group representatives of the aldehyds and the true alcohols. He succeeds in obtaining and examining isonaphthoe aldehyd, $C_{10}H_7CHO$; hydroisonaphthamide, $(C_{10}H_7CH)_3N_2$; two isomeric acids α and β sulphonaphthœic acids and the barium, calcium, potassium, and copper salts of the former; oxynaphthœic acid; sulphoisonaphthœic acid with its barium salt; and oxyisonaphthœic acid.

On a Change in Cast-Iron Produced by the Action of a Mineral Sulphur Water.—Dr. E. Priwoznik.—An iron water-pipe which had been exposed for twelve years to the action of water rich in the sulphide of hydrogen was examined. The innermost stratum consisted of—

Hydrated oxide of iron	81·08
Free sulphur..	12·29
Sulphide of iron	4·48
Hygroscopic water	0·57
Nickel, cobalt, magnesia, silicic acid (soluble and insoluble), traces of carbon, and chlorides of ammonium and sodium ..	1·58
	100·00

This stratum is, therefore, an intimate mixture of hydrated oxide of iron, sulphide of iron, and sulphur. The hydrated oxide has the composition $2Fe_2O_3.3HO$, and is therefore identical with limonite. The middle stratum contained 79·2 per cent of metallic iron, and the exterior 92·6.

On Sulph-Hydantoïn (Glycolyl-Sulphurea).—Richard Maly.—The author obtains monochloracetyl-sulphurea by the mutual reaction of monochloracetic acid and sulphocarbamid. From this product sulph-hydantoïn is readily obtained.

Determination of the Boiling-Point of Liquids at a Normal Atmospheric Pressure of 760 m.m.—Dr. H. Bunte.—The author has devised an apparatus for dispensing with correction for the varying barometric pressure.

Preparation of Trimethyl-Carbinol by the Method of Linnemann.—A. Butteron.—The author criticises Linnemann's process, and seeks for an explanation of the details necessary for success.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, July 14, 1873.

On a New Deposit of Struvite.—Robert Otto.—In pulling down a house in the Knochenhauer Strasse, in

Brunswick, there was found about seven feet below the level of the pavement a stratum of decomposed excrement several feet thick, and interspersed with crystals which, according to their chemical and physical properties, consist of struvite.

Chemical Composition of Vesuvian.—C. Rammelsberg.—Former researches seemed to show that the composition of garnet and vesuvian were identical—a result confirmed upon the whole by the experiments of Magnus. The more recent analyses of the author, as well as those of Hermann and Scheerer, indicated the general formula, $R_{18}R_4Si_{15}O_{60}$. Magnus found that the vesuvian of Wilni lost 0·7 per cent on ignition; the author showed that in all other cases this loss amounted to 2 to 3 per cent, and consisted of water. The yellow and brown vesuvian of Mongoni, the vesuvians of Ala, Zermatt, Haslan, and Wilni were re-examined. In all, R : Si = 1 : 3·5; in all except that of Wilni, R : R = 1 : 4, and (H,K) : R = 1 : 2·66; in that of Wilni, R : R = 1 : 4·5, and (H,K) : R = 1 : 9. Hence, for the majority, the formula is $H_3R_8R_2Si_7$, and for that of Wilni $HR_9R_2Si_7$.

On Certain Derivatives of Normal Propyl Alcohol.—H. Roemer.—The author has prepared and examined the mercaptan, C_3H_7SH; á mercaptid, $(C_3H_7S)_2Hg$; the propyl-xanthogenate of potassa, a tripropyl-biuret,—

$$CON_2(C_3H_7)_3CONH_2;$$

tetra-propyl-ammonium-iodide, and tetra-propyl-ammonium-oxydhydrate.

On Pyruvic Acid.—C. Böttinger.—The author had previously shown that during the transformation of pyruvic acid into uvitinic acid, the intermediate product hydrovinic acid is concerned. More recently he has prepared large quantities of pyruvic acid to examine in detail the transformation of basic hydrovinate of baryta, and especially to examine the residual syrupy acid named by Tinkle uvitonic acid.

On Chlortoluols.—H. Hübner and W. Majert.—The authors have formed and examined the ortho-chlortoluol sulphates of baryta, lime, lead, potash, soda, copper, copper-ammonia, and ammonia; the acid ortho-chlortoluol-sulphobenzoates of potash, baryta, and lead; the metatoluol sulphates of baryta and lead; the β-parachlortoluol sulphates of baryta, lime, lead, potash, copper, and copper-ammonia; and the α-para-chlortoluol sulphates of baryta and soda.

On Amido-Benzol, and a Simple Preparation of Meta-Diamidobenzol.—H. Hübner and H. Retschy.—If two constituents differing from hydrogen are introduced into benzol two pairs of compounds will be derivable, which may possibly be only distinguished by the manner of the combination of the atoms of carbon. With this purpose the authors examine diamidobenzol.

On Isomeric Brom-Toluidines.—H. Hübner and P. E. Roos.—The authors have found and examined a para-bromnitro compound, and obtained by amidising it α-para-bromtoluidin, and certain of its salts.

On Meta-bromtoluol.—H. Hübner and E. A. Grete.—The authors dissolved meta-bromtoluol in fuming sulphuric acid, and examined its barium salt.

On Benzyl-Dichloride Simultaneously Treated with Chlorine and Nitric Acid.—H. Hübner and F. Bente.—One of the authors had on a former occasion begun to examine the question whether all elements or groups of a decidedly homologous character, whether decidedly chemico-negative (acid) or chemico-positive (basic), replace the same atom of hydrogen in hydrocarbons. In the majority of cases the behaviour of such bodies was found to be absolutely identical. Certain exceptions, however, became apparent. Thus Beilstein and Kuhlberg observed that benzyl-dichloride with chlorine yields para-chlor-benzyl dichloride, $C_6H_2ClH_2.CHCl_2$, and, on oxidation, para-chlor-benzoic acid, whilst benzyl dichloride with nitric acid yields a nitro-compound, which, on oxidation, gives meta-nitro-benzoic acid, instead of para-nitro-benzoic acid as might be expected. This subject the authors have further examined.

Absorption of Ozone in Water.—L. Carius.—The author has previously shown that ozone can be absorbed by water unchanged in quantities not inconsiderable. He now finds that at the temperature 0°, and a pressure of 0·76 m.m., 1·346 c.c. of ozone were absorbed by 100 c.c. of water; this is independent of the amount of oxygen absorbed. The ozone used in these experiments was obtained by electric action.

Relative Position of the Lateral Links in Zincke's Hydrocarbons.—Br. Radziszewski.—A purely theoretical, or rather hypothetical, paper.

Remarks on the Structure of Aromatic Bodies.—Br. Radziszewski.—The same remark applies to this paper.

On Aromatic Phosphorus Compounds.—A. Michaelis.—The author has examined—Phosphenyl chloride, phosphenyl tetrachloride, phosphenyl chlorobromide, phosphenyl chlorotetrabromide, phosphenyl oxychloride, and phosphenylic acid.

On Steam Press Filters.—Arnold Heintz.—The apparatus described is ingenious, and will probably be useful. The description would be unintelligible without the accompanying diagram.

MISCELLANEOUS.

The Adulteration Act.—The Board of Works for the district of Greenwich has just complied with the requirements of the Local Government Board in appointing a public analyst, under the provisions of the Adulteration Act. Out of seven candidates for the appointment, at the meeting of the Board on Wednesday, Mr. Wigner, of 79, Great Tower Street, public analyst for Plumstead district, was chosen.

To Fasten Leather upon Metal.—F. Sieburger recommends the process proposed by the late Prof. Fuchs:—One part of crushed nutgalls is digested six hours with eight parts distilled water, and strained. Glue is macerated in its own weight of water for twenty-four hours, and then dissolved. The warm infusion of galls is spread upon the leather, the glue solution upon the roughened surface of the warm metal, the moist leather is pressed upon it and then dried, when it adheres so that it cannot be removed without tearing.—*Polyt. Notizbl.*

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in treating certain gases for lighting and heating purposes, and in combining atmospheric air therewith. Charles Weightman Harrison, High Holborn, Middlesex. January 1, 1873.—No. 1. The novelty of this invention consists in carburetting or increasing the proportion of carbon in hydrocarbon gases, such as coal-gas, and afterwards mixing or combining therewith atmospheric air.

Improvements in apparatus employed in the manufacture of salt. Otto Ernest Pohl, salt manufacturer and merchant, Liverpool. January 1, 1873.—No. 4. This relates to evaporating apparatus in which the flames or heating gases are passed between two pans, and consists in covering the top of the bottom pan with sheet-iron or other material, preferably formed channelwise when viewed in transverse section. The bottom pan is made wider than the top one, to allow rakes to be conveniently used.

Improvements in treating waste products and other materials containing zinc for the purpose of recovering zinc and other valuable products therefrom, and in apparatus to be employed for that purpose. Charles Boundy, metal broker, Birmingham. January 1, 1873.—No. 17. According to this invention the waste product or material, consisting principally either of hard spelter, old zinc, new zinc cuttings, or zinc riddlings from galvanisers' ashes, is placed upon the top of an incline, forming the bed of a muffle or nearly closed chamber, and heated so as to sweat from out of it the zinc, which zinc runs down the said inclined bed, carrying with it any lead which may be contained in the material, and also solid particles of foreign matters. The liquid metal collects in the first of a set of receivers situated at the bottom of the bed. In the first receiver a large portion of the solid matter carried with the metals falls to the bottom. The metal in this receiver is removed from time to time, the upper part being poured back, and

the lower part being cast into ingots and treated again. As the first receiver becomes filled, the zinc overflows into the next receiver, and so on, where a spontaneous separation of the kind described takes place. The separated and purified zinc finally collects in a large pan or reservoir, and may be cast into ingots or otherwise. Before treating zinc riddlings from galvanisers' ashes by the process described, they undergo a preliminary treatment for the purpose of utilising the sal-ammoniac and oxide of zinc contained in the said ashes.

Improvements in the manufacture of paints. William Britton Stephens, 67, Strand, Westminster. January 3, 1873.—No. 35. The application and use of slaked lime or plaster of Paris, one or the other, or both, instead of, or in combination with, the usual bases employed in the manufacture of paint.

Improvements in the purification of water, and in the means and apparatus employed for that purpose. Gustav Bischof, Professor of Technical Chemistry, Andersonian University, Glasgow. January 3, 1873.—No. 38. This invention has reference to the process of purifying water by filtering it through spongy iron, for which Letters Patent No. 2516 of 1870 were granted to the petitioner. The present invention consists in causing the water to filter through marble or limestone after passing through the spongy iron in order to remove the iron taken up by the water. Filters for this purpose are described, consisting of a vessel with perforated bottom containing the spongy iron, placed above a vessel with perforated bottom containing the marble or limestone, and arrangements are described whereby the water, after filtering through the spongy iron, is made to rise to the level of the spongy iron again before flowing down on to the marble or limestone, in order to keep the spongy iron always immersed. Animal charcoal may also be employed in place of the marble or limestone for retaining the iron.

An improved process and apparatus for extracting oleaginous or fatty matters from liquid or solid substances. William Gordon Thompson, manufacturing chemist, Manchester. January 3, 1873.—No. 42. The object of this invention is to separate oleaginous and fatty matters from various substances with which they may be combined, so that such oily or fatty matters when separated may be applied for various purposes in the arts.

Improvements in means or apparatus for the distillation of ammoniacal liquors, which improvements are also applicable in the distillation of other liquids, and in the concentration of soluble salts. Alexander Angus Croll, civil engineer, Coleman Street, London. January 4, 1873.—No. 45. The invention relates to means by which the liquid matter to be acted upon is received into the upper of a series of evaporating trays or chambers, and, in overflowing that, passes to the next, and thence to each in succession until it arrives at the lowest, which is that immediately over and surrounding the fire. The heat from the fire passes up through the centre of the lower chamber, thence radially over the liquor in that chamber and under the chamber next above, and thence under and over each to the outlet. The fire-door of the furnace is sealed after the supply of each charge, to cause all the atmospheric air to pass through the fire, and such air is forced upwards or forwards where the vapour has to pass through another media, as in the manufacture of sulphate of ammonia, or it may be drawn by vacuum.

Improvements in obtaining valuable substances derivable from residual liquors produced in the manufacture of alum from phosphates of alumina. Peter Spence, manufacturing chemist, Newton Heath, Manchester. January 4, 1873.—No. 50. This invention refers to obtaining valuable substances from the liquor arising from the manufacture of alum by the process patented by the present inventor dated June 9, 1870, No. 1676.

NOTES AND QUERIES.

Pure Anthracen.—Could any of readers kindly inform me of any accurate method of estimating the amount of pure anthracen in crude anthracen. I have tried one or two methods considered to be the *most* accurate, but these give far from good results. I shall feel greatly obliged to anyone who can favour me with an answer.—W. C. P.

Carbolic Soap.—I would be obliged if your readers could give me any information about the manufacture of carbolic soap used for sheep-washing. I believe it is made from soft soap and carbolic acid; I should like to know how the two ingredients are mixed together, in what quantity, the strength of the carbolic acid to be used, and how much to be used for washing each sheep, and if it is a cure for the scab in sheep.—B. WOTTON.

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J. G. F.—Our "Students' Number," which will be published early next month, will contain full information respecting the examinations for B.Sc. and D.Sc. degrees.

J. H. F.—We do not know the composition of "Oroide of Gold" or "Persian Silver."

G. A.—Your communication does not contain sufficient novelty to warrant its insertion.

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N.B.—Mr. D. wishes an Engagement between London and Bath, for Monday, the 25th inst. Terms, Two Guineas.

THE CHEMICAL NEWS.

Vol. XXVIII. No. 717.

THE CHEMICAL CONSTITUTION OF SUCCINIC, MALIC, AND TARTARIC ACIDS, CRITICALLY EXAMINED AND INTERPRETED FROM THE STAND-POINT OF THE "TYPO-NUCLEUS" THEORY.

By OTTO RICHTER, Ph.D.

(Continued from p. 77).

Part II.

On the Principal Molecular Changes which the Water-Salts of Succinic, Malic, and Tartaric Acids are prone to experience under the influence of Heat and Oxidising Agents.

This part may be conveniently divided into two chapters, the one to treat on the effects of heat, and the other on the effects of oxidising agents, upon these compounds.

Chapter I.

On the Effects of Heat upon the Water-Salts of Succinic, Malic, and Tartaric Acids.

(1). Let us, in the first place, contemplate the effects of temperature when the ordinary succinate is mixed with hydrate of lime. On treating the resulting lime-salts with hydrochloric acid, carbonic acid is given off, and a substance is found in the distillate which, in composition and properties, agrees with the normal propionate of water. In musing upon the nature of this evidently very complicated reaction, I soon came to comprehend that its course must be marked by a number of well-defined transition products—among others, by the occurrence of two isomeric modifications of the succinate. One of these isomerides, to which I will apply the term "iso-succinate," is no doubt identical with a compound realised some time ago by boiling one of the two varieties of cyan-propionate with potash ley (*vide* Part III.); while the other, to which I will apply the term "para-succinate," remains yet to be discovered. The rationale of the entire process may be given in the following words:—

In the first stage, the succinate of lime splits up into 2 molecules of water, derived from the formylic alcohol ally and the unknown succinéate of lime—

$$\begin{array}{lll} & H_2O_2. & Ca_2O_2.\ Ca_2O_2. \\ \alpha) & 2(\overline{C_2 : C_2}) ; & H_2O_2 : 2C_2O - 2C_2O_3, \\ \beta) & 2C_4 ; & \end{array}$$

whose formula implies that the liberated formen has coalesced with the formen adjunct of the unaltered principal under the double form of biformen or deacetylen. At the same time the two liberated water molecules become decomposed, so as to yield up their oxygen to the oxalous acid ally, while their hydrogen unites with the biformen or deacetylen adjunct. The resulting product is, therefore, a molecule of iso-succinate of lime—

$$\begin{array}{lll} & H_2O_2. & Ca_2O_2.\ Ca_2O_2. \\ \alpha) & 2(\overline{H_2C_2 : C_2}) ; & H_2O_2 : 2C_2O - 2C_2O_3. \\ \beta) & 2H_2C_4 ; & \end{array}$$

In the second stage, the colligated methylen-formylic or acetylic alcohol breaks up into 2 molecules of water and the corresponding hydrocarbon, which instantly reunites as adjunct with the oxalous acid principal; at the same time the two liberated water molecules suffer decomposition, so as to yield up their oxygen to that principal, while their hydrogen unites with its freshly-acquired hydrocarbon adjunct. The resulting product is, therefore, the para-succinate of lime—

$$\begin{array}{lll} & & Ca_2O_2.\ \ Ca_2O_2. \\ \alpha) & 2(\overline{H_4C_2 : C_2}) ; & 2C_2O_3 : 2C_2O_3, \\ \beta) & 2H_4C_4 ; & \end{array}$$

with methan-formen or ethylen for an adjunct.

Before proceeding farther, it behoves me to state that this latter isomeride differs materially from its two predecessors, in this respect: that it is no longer amenable to the original type of de-alcohol-conjugated polyatomic water-salts, but that it has suddenly become transferred to the typically-distinct class of hydrocarbon-conjugated polyatomic water-salts (a species of typical metamorphosis which, in my system of notation, is indicated by the substitution of the symbol (:) for the symbol (~)).

Finally, a mere glance at my formula suffices to show, that the carbonic acid must derive from the oxalic acid ally of the para-succinate, which has become oxidised at the expense of its freshly-acquired water base, while the liberated hydrogen unites with the hydrocarbon adjunct of the oxalic acid principal. The end product of this highly-interesting and instructive reaction is, therefore, the propionate of lime—

$$\begin{array}{lll} & & Ca_2O_2. \\ \alpha) & 2(\overline{H_4C_2 : HC_2}) ; & 2C_2O_3, \\ \beta) & 2H_5C_4 & \end{array}$$

the α variety of which I believe to be identical with the iso-propionate of our handbooks, while the β variety corresponds to the normal propionate.

(2). Let us, in the second place, consider the effects of heat upon the ordinary malate. These effects may be more advantageously studied and explained in connection with the process of fermentation, which the malate is known to undergo whenever the combined energies of lime-water, a so-called ferment, and a suitable temperature are made to bear upon it. The chief products of the reaction consist in a mixture of the lime-salts of carbonic, iso-lactic (ordinary lactic), acetic, succinic, and butyric acids: and the principal molecular changes which characterise the different stages of this hitherto obscure and unfathomable process may be described as follows:—

In the first stage, the malate of lime splits up into 2 molecules of water and the well known maléate of lime—

$$\begin{array}{lll} & H_2O_2. & Ca_2O_2.\ Ca_2O_2. \\ \alpha) & 2(\overline{C_2 : C_2}) ; & H_2O_2 : 2C_2O - 2C_2O_3, \\ \beta) & 2C_4 ; & \end{array}$$

the heterologue of the afore-mentioned succinéate of lime, and the β variety of which I hold to be identical with the fumarate of our handbooks. At the same time the two liberated water molecules suffer decomposition, so as to yield up their oxygen to the oxalous acid principal, while their hydrogen unites with the biformen or deacetylen adjunct. The resulting product is, therefore, the isomalate of lime—

$$\begin{array}{lll} & H_2O_2. & Ca_2O_2.\ Ca_2O_2. \\ \alpha) & 2(\overline{H_2C_2 : C_2}) ; & 2H_2O_2 : 2C_2O_3 - 2C_2O_3. \\ \beta) & 2H_2C_4 ; & \end{array}$$

The second stage is marked by the resolution of this lime-salt into carbonic acid, derived from the oxidation of the oxalic acid ally at the expense of its own freshly-acquired water-base, and the isolactate of lime—

$$\begin{array}{lll} & H_2O_2. & Ca_2O_2. \\ \alpha) & 2(\overline{H_2C_2 : C_2}) ; & H_2O_2 : 2H ; 2C_2O_3, \\ \beta) & 2H_2C_4 ; & \end{array}$$

the α variety of which remains yet to be discovered, while the β variety corresponds to the ordinary lactate of our handbooks.

It is upon the new basis of the isolactate of lime that I shall now proceed to expound the molecular changes, which accompany the production of the acetate and succinate of lime on the one hand, and the butyrate of lime on the other hand.

In the first place, as regards the acetate and succinate of lime. These two lime-salts, which require for their production the co-operation of 1 molecule of isolactate and 2 molecules of unaltered malate of lime, are formed simultaneously, in virtue of the following reaction:—First of all, the isolactate of lime resolves itself into a molecule of methylen-formylic or acetylic alcohol, both of which speedily merge into the isomeric acetite of water and into a molecule of formate of lime. The acetite then becomes oxidised into the acetate at the expense of 2 molecules of water, while the liberated hydrogen serves to reduce one of the accessory molecules of malate, with production of a molecule of succinate of lime. In like manner, the formate becomes oxidised into the formoate of lime at the expense of 2 molecules of water, while the liberated hydrogen serves to reduce the other accessory molecule of malate, with production of a second molecule of succinate of lime. Finally, the newly-formed acetate of water, by transposing with the formoate of lime, gives rise to acetate of lime and the unstable formoate of water, which speedily resolves itself into 2 molecules of water and carbonic acid.

In the second place, as regards the butyrate of lime. This compound, which requires for its generation an excess of ferment, as well as a higher temperature, is derived from two molecules of isolactate, through the following series of molecular changes:—In the first stage, one of the isolactate of water molecules breaks up into a molecule of methylen-formylic or acetylic alcohol and a molecule of formate of lime. The formic acid constituent of this latter instantly unites as ally with the formic acid principal of the other molecule of unaltered isolactate. The resulting bibasic meta lime-salt is therefore expressed by the formula—

$$\begin{array}{l} \qquad\qquad H_2O_2. \qquad Ca_2O_2. \qquad Ca_2O_2. \\ \alpha)\ \overline{2(H_2C_2 : C_2)\,;\, H_2O_2 \,\vdots\, 2H\,;\, 2C_2O_3 - 2H\,;\, 2C_2O_3}. \\ \beta)\quad 2H_2C_4\,; \end{array}$$

With the aid of 2 molecules of water, the liberated alcohol has at the same time become converted into the glycolic alcohol—

$$\frac{H_2O_2. \qquad H_2O_2.}{2C_2\,;\, H_2O_2 \,\vdots\, 2H_2C_2\,;\, H_2O_2}.$$

We now arrive at a remarkably interesting feature of the process, which is, that the ensuing molecular changes are due entirely to the reducing action of the glycolic alcohol on the afore-mentioned meta lime-salt. Accordingly, the first stage is marked by the separation of 2 molecules of hydrogen from the methylen adjunct of the glycolic alcohol, and their immediate conversion into 2 molecules of water at the expense of the formic acid principal of the meta lime-salt. The resulting products are, therefore, a molecule of the reduced, but still bibasic, meta lime-salt—

$$\begin{array}{l} \qquad\qquad H_2O_2. \qquad Ca_2O_2. \qquad Ca_2O_2. \\ \alpha)\ \overline{2(H_2C_2 : C_2)\,;\, H_2O_2 \,\vdots\, 2H\,;\, 2C_2O - 2H\,;\, 2C_2O_3}, \\ \beta)\quad 2H_2C_4\,; \end{array}$$

and a molecule of de-glycolic alcohol, which speedily merges into the isomeric glycolite of water—

$$\frac{H_2O_2. \qquad H_2O_2.}{2C_2\,;\, H_2O_2 \,\vdots\, 2H\,;\, 2C_2O}.$$

Subsequently, the reduced meta lime-salt, after transposing with the glycolite of water, becomes converted into the monobasic lime-salt—

$$\begin{array}{l} \qquad\qquad H_2O_2. \qquad H_2O_2. \qquad Ca_2O_2. \\ \alpha)\ \overline{2(H_2C_2 : C_2)\,;\, H_2O_2 - 2C_2\,;\, H_2O_2 \,\vdots\, 2H\,;\, 2C_2O_3}, \\ \beta)\quad 2H_2C_4\,; \end{array}$$

which, by the loss of 2 molecules of water, derived from the splitting up of the formylic alcohol ally, becomes still further changed into the lime-salt—

$$\begin{array}{l} \qquad\qquad H_2O_2. \qquad Ca_2O_2. \\ \alpha)\ \overline{2(H_2C_4 : C_2)\,;\, H_2O_2 \,\vdots\, 2H\,;\, 2C_2O_3}. \\ \beta)\quad 2H_2C_6\,; \end{array}$$

The next stage is marked by the conversion of the newly-formed glycolite of lime into the glycolate—

$$\frac{H_2O_2. \qquad Ca_2O_2.}{2C_2\,;\, H_2O_2 \,\vdots\, 2H\,;\, 2C_2O_3},$$

at the expense of 2 molecules of water, while the liberated hydrogen unites with the hydrocarbon adjunct of the afore-mentioned lime-salt, with production of the isobutolactate of lime—

$$\begin{array}{l} \qquad\qquad H_2O_2. \qquad Ca_2O_2. \\ \alpha)\ \overline{2(H_4C_4 : C_2)\,;\, H_2O_2 \,\vdots\, 2H\,;\, 2C_2O_3}. \\ \beta)\quad 2H_4C_6\,; \end{array}$$

In the last stage, the ethylen-formylic or allylic alcohol of this latter compound splits up into 2 molecules of water and the corresponding hydrocarbon, which, by its immediate union with the formic acid principal, gives rise to a molecule of crotonate of lime—

$$\begin{array}{l} \qquad\qquad Ca_2O_2. \\ \alpha)\ \overline{2(H_4C_4 : HC_2)\,;\, 2C_2O_3}\,; \\ \beta)\quad 2H_5C_6\,; \end{array}$$

at the same time, the two liberated water molecules suffer decomposition, so as to surrender their oxygen to the glycolate, while their hydrogen unites with the hydrocarbon adjunct of the crotonate. The resulting products are, therefore, a molecule of butyrate and a molecule of glycolate of lime, with the respective formulæ—

$$\begin{array}{l} \qquad\qquad Ca_2O_2. \\ \alpha)\ \overline{2(H_6C_4 : HC_2)\,;\, 2C_2O_3} \\ \beta)\quad 2H_7C_6\,; \end{array}$$

and—

$$\frac{H_2O_2. \qquad Ca_2O_2.}{2C_2\,;\, H_2O_2 \,\vdots\, 2H\,;\, 2C_2O_5}.$$

The preceding train of reasoning, regarding the soundness of which I must leave the reader to judge for himself, clearly proves that the evolution of hydrogen gas, which never fails to accompany the butyric fermentation, is due entirely to a secondary reaction, the cause of which is not far to seek. For we may well suppose that, under the combined influence of excess of ferment and a high temperature, the aforesaid glycoloate of lime splits up into the formylic alcohol and the formoate of lime, which, by transposing with the formite of water, into which the formylic alcohol has been made to pass, gives rise to formite of lime and the unstable formoate of water. The latter splits up into 2 molecules of water and carbonic acid, while the formite becomes oxidised, first into the formate, and afterwards into the formoate of lime, indubitably at the expense of the aqueous solvent, from which an equivalent quantity of hydrogen gas must therefore become evolved.

(3). Let us, in the last place, contemplate the effects of temperature upon the ordinary tartrate of water. When this substance is heated up to a certain point, it loses 2 molecules of water, and along with it the character of solubility; at the same time it ceases to exhibit the acid properties of an organic water-salt, while a few degrees below that point it retains still a distinctly acid reaction. Now, at first sight, and with no other facts to guide us, we might naturally take the insoluble product to be the ortho-tartaric anhydride—

$$\frac{H_2O_2. \qquad H_2O_2.}{2C_2\,;\, H_2O_2 - 2C_2\,;\, H_2O_2 \,\vdots\, 2C_2O_2 - 2C_2O_4}\,;$$

but, after examining more closely into these relations, we are constrained to admit that this body is only an isomeric modification of the former, and, so far as I know, still unisolated compound. I have come to the conclusion that the insoluble product is the meta-tartaric anhydride—

$$\begin{array}{l} \qquad\qquad H_2O_2. \\ \alpha)\ \overline{2(C_2 : C_2)\,;\, H_2O_2 \,\vdots\, 2H\,;\, 2C_2O_4 - 2H\,;\, 2C_2O_4}, \\ \beta)\quad 2C_4\,; \end{array}$$

and I consider that the conversion of the soluble variety, or the so-called tartrélate—

$$\begin{array}{l} \qquad\qquad H_2O_2.\ H_2O_2.\quad H_2O_2. \\ \alpha)\ \overline{2(C_2:C_2)\,;\,H_2O_2\,!\,2C_2O_3\frown 2C_2O_3}, \\ \beta)\quad 2C_4\,; \end{array}$$

into this body is readily explained on the hypothesis that the two oxalic acid constituents become oxidised at the expense of their own water bases, while the liberated hydrogen re-unites as adjunct with the carbon nuclei of the freshly-formed bicarbonic acid constituents. It is self-evident, that the re-conversion of the meta-tartaric anhydride into the tartrélate must be attended by a series of molecular changes, in which the order of molecular movements is absolutely reversed.

The reader cannot help admitting, that the two kinds of molecular rearrangement just described, in virtue of which an organic water-salt becomes suddenly deprived of one of its most characteristic chemical properties, and as suddenly re-endowed again, is a fact of the deepest theoretical value and significance. Having, in the course of my researches, become acquainted with a considerable number and variety of analogous cases, I have found it expedient to make use of the terms "ortho-genesis" and "meta-genesis," the former to denote the conversion of a meta-anhydride into the corresponding ortho water-salt, and the latter to denote the conversion of an ortho water-salt into the corresponding meta-anhydride.

The preceding remarks will, I trust, enable the reader to comprehend the precise nature of the molecular changes which accompany the action of heat on the ortho-tartrate up to the point where it changes into the meta-tartrate—

$$\begin{array}{l} \qquad\qquad H_2O_2.\qquad H_2O_2.\qquad\quad H_2O_2. \\ \alpha)\ \overline{2(C_2:C_2)\,;\,H_2O_2\,!\,2H\,;\,2C_2O_3\frown 2H\,;\,2C_2O_5}. \\ \beta)\quad 2C_4\,; \end{array}$$

And here I may notice a peculiarity of the tartrate, whereby it differs remarkably from its two lower heterologues, and which consists in the circumstance, that its dehydration is invariably preceded by the formation of the meta-tartrate, while compounds corresponding to a meta-succinate and meta-malate, although theoretically possible, are as yet entirely unknown. This difference may be accounted for on the hypothesis that, in the existing conditions of the experiment, the tartrate is prone to merge into the isomeric meta-anhydride—

$$\overline{2C_2\,;\,H_2O_2\frown 2C_2\,;\,H_2O_2\,!\,2H\,;\,2C_2O_4\frown 2H\,;\,2C_2O_4},$$

corresponding to the bibasic meta water-salt which, the reader will recollect, was encountered as a transition product in the oxidation of the tetratomic butylen erythrol.

Let us, further, suppose that this compound resolves itself into 2 molecules of water and the meta-tartaric anhydride—

$$\begin{array}{l} \qquad\qquad H_2O_2. \\ \alpha)\ \overline{2(C_2:C_2)\,;\,H_2O_2\,!\,2H\,;\,2C_2O_4\frown 2H\,;\,2C_2O_4}, \\ \beta)\quad 2C_4\,; \end{array}$$

and that these two water molecules, instead of being eliminated, are instantly brought to re-unite as water bases with the acid constituents of the anhydride; we shall then, by this practical application of the above-mentioned method of meta-genesis, have put ourselves in possession of a powerful argument in support of the assertion, that the meta-tartrate of water is really constructed on the pattern of the formula assigned to it.

In all the cases hitherto examined, the bodies obtainable by the action of heat on the tartrate have this point in common, that they contain the same equivalent number of carbon molecules as the alcohol, from which they are descended. Let us now contemplate the case when, through the more energetic interposition of the same physical agent, the tartrate is forced to part with a certain portion of that element. In this process the carbon is always eliminated under the form of carbonic acid, while the contents of the receiver are found to consist of the ordinary glycerate of water—

$$\overline{2C_2\,;\,H_2O_2\frown 2C_2\,;\,H_2O_2\,!\,2H\,;\,2C_2O_3}.$$

Evidently the carbonic acid is here, as it is in the majority of cases, derived from the oxalic acid ally, which becomes oxidised into this anhydride at the expense of its own water base; while the liberated hydrogen, by re-uniting as adjunct with the oxalic acid principal, transforms it into a formic acid principal. The resulting product is, therefore, a molecule of the glycerate, as formulated above. When the glycerate is strongly heated in its turn, it splits up into 2 molecules of water, derived from the formen-holding ally, and the pyruvate—

$$\begin{array}{l} \qquad\qquad H_2O_2.\qquad H_2O_2. \\ \alpha)\ \overline{2(C_2:C_2)\,;\,H_2O_2\,!\,2H\,;\,2C_2O_3}, \\ \beta)\quad 2C_4\,; \end{array}$$

which, by this formula, is shown to occur in two isomeric modifications. Finally, when the pyruvate is strongly heated in its turn, 2 molecules of this compound are observed to conspire towards the production of 1 molecule of the ordinary pyrotartrate, while carbonic acid is given off.

In this highly interesting and instructive metamorphosis, one of the two pyruvate of water molecules resolves itself, on the one hand, into a molecule of formate of water, the formic acid constituent of which instantly unites as ally with the formic acid principal of the other unaltered pyruvate of water molecule, with production of the bibasic meta water-salt—

$$\begin{array}{l} \qquad\qquad H_2O_2.\qquad H_2O_2.\qquad\quad H_2O_2. \\ \alpha)\ \overline{2(C_2:C_2)\,;\,H_2O_2\,!\,2H\,;\,2C_2O_3\frown 2H\,;\,2C_2O_3}, \\ \beta)\quad 2C_4\,; \end{array}$$

and, on the other hand, into the biformylic or deacetylic alcohol, which (after previous conversion of the β into the α variety) speedily surrenders first the one and then the other of its constituent formen molecules to the biformen or deacetylen adjunct of the aforesaid meta water-salt, with production of a still more highly carbonated bibasic meta water-salt—

$$\begin{array}{l} \qquad\qquad H_2O_2.\qquad H_2O_2.\qquad\quad H_2O_2. \\ \alpha)\ \overline{2(C_2:C_2:C_2:C_2)\,;\,H_2O_2\,!\,2H\,;\,2C_2O_3\frown 2H\,;\,2C_2O_3}. \\ \beta)\quad 2(C_4:C_2:C_2)\,; \end{array}$$

Subsequently, the formic acid ally of this compound becomes oxidised into a formoic acid ally at the expense of the two liberated water molecules, while their hydrogen unites with the complex carbon adjunct. By the method of ortho-genesis, the resulting bibasic meta water-salt—

$$\begin{array}{l} \qquad\qquad H_2O_2.\qquad H_2O_2.\qquad\quad H_2O_2. \\ \alpha)\ \overline{2H_2C_2:C_2:C_2:C_2)\,;\,H_2O_2\,!\,2H\,;\,2C_2O_3\frown 2H\,;\,2C_2O_5}, \\ \beta)\quad 2(H_2C_4:C_2:C_2)\,; \end{array}$$

becomes then converted into the isomeric ortho water-salt—

$$\begin{array}{l} \qquad\qquad H_2O_2.\qquad H_2O_2.\ H_2O_2.\quad H_2O_2. \\ \alpha)\ \overline{2(H_2C_2:C_2:C_2)\,;\,H_2O_2\frown 2C_2\,;\,H_2O_2\,!\,2C_2O_3\frown 2C_2O_3}, \\ \beta)\quad 2(H_2C_4:C_2)\,; \end{array}$$

which speedily resolves itself into carbonic acid and the monobasic water-salt—

$$\begin{array}{l} \qquad\qquad H_2O_2.\qquad H_2O_2.\qquad\quad H_2O_2. \\ \alpha)\ \overline{2(H_2C_2:C_2:C_2)\,;\,H_2O_2\frown 2C_2\,;\,H_2O_2\,!\,2H\,;\,2C_2O_3}. \\ \beta)\quad 2(H_2C_4:C_2)\,; \end{array}$$

This latter, again, soon merges into the isomeric modification of the bibasic meta-pyrotartrate—

$$\begin{array}{l} \qquad\qquad H_2O_2.\qquad H_2O_2.\qquad\quad H_2O_2. \\ \alpha)\ \overline{2(H_2C_2:C_2:C_2)\,;\,H_2O_2\,!\,2H\,;\,2C_2O\frown 2H\,;\,2C_2O_3}, \\ \beta)\quad 2(H_2C_4:C_2)\,; \end{array}$$

which, by the method of orthogenesis, is finally transformed into the ordinary or ortho-pyrotartrate—

$$\begin{array}{l} \qquad\qquad H_2O_2.\qquad H_2O_2.\ H_2O_2.\quad H_2O_2. \\ \alpha)\ \overline{2(H_2C_2:C_2)\,;\,H_2O_2\frown 2C_2\,;\,H_2O_2\,!\,2C_2O\frown 2C_2O}. \\ \beta)\quad 2(H_2C_4)\,; \end{array}$$

As it is my intention of resuming the subject of pyrotartaric acid in a future communication, the reader is now requested to scrutinise the contents of the second chapter.

Chapter II.

On the Effects of Oxidising Agents upon the Ordinary Malate and Tartrate of Water.

The chief products of this process are found to be the malonate and tartronate of water, while carbonic acid is given off in both cases. The formulæ—

$$\frac{H_2O_2.\ H_2O_2.\ H_2O_2.}{2C_2\,;\,H_2O_2 : 2C_2O \frown 2C_2O_3}$$

and—

$$\frac{H_2O_2.\ H_2O_2.\ H_2O_2.}{2C_2\,;\,H_2O_2 : 2C_2O_3 \frown 2C_2O_3},$$

bear witness that, like their parent molecules, these two derivatives stand to each other in the relation of true heterologues, whilst the lowest member of this family-group, with the formula—

$$\frac{H_2O_2.\ H_2O_2.\ H_2O_2.}{2C_2\,;\,H_2O_2 : 2C_2O \frown 2C_2O},$$

remains yet to be discovered.

The reader will at once admit that this triad of acid heterologues must be descended from the olefine-begotten triatomic propylen-glycerol, that being the identical alcohol which, by oxidation, is known to furnish the ordinary glycerate. The following two cases appear to me well adapted to elucidate the precise nature of those family ties, that connect the glycerate with the two compounds under consideration; but, before entering more deeply into this subject, I have deemed it advisable to interweave a few remarks explanatory of the genetic relations which subsist between the tartronate and divers other organic combinations, as, for example, the mesoxalate, glycolate, and glyoxalate. Thus, it is proved by experiment—(1) That, under the influence of heat, the tartronate splits up into carbonic acid and the glycolate, according to the equation—

$$\frac{H_2O_2.\ H_2O_2.\ H_2O_2.}{2C_2\,;\,H_2O_2 : 2C_2O_3 \frown 2C_2O_3} = \frac{H_2O_2.\qquad H_2O_2.}{= 2C_2O_4 + 2C_2\,;\,H_2O_2 : 2H\,;\,2C_2O_3};$$

(2) that nascent hydrogen converts the mesoxalate into the tartronate, according to the equation—

$$\frac{H_2O_2.\ \ H_2O_2.}{2C_2O_2 : 2C_2O_3 \frown 2C_2O_3} + 2H_2 = \frac{H_2O_2.\ H_2O_2.\ H_2O_2.}{= 2C_2\,;\,H_2O_2 : 2C_2O_3 \frown 2C_2O_3},$$

where, in striking contrast with received notions, the reducing energies of the hydrogen are expended upon the carbonic oxide adjunct in preference to the more highly-oxidised oxalic acid principal; (3) that heat causes the mesoxalate to split up into carbonic acid and the glyoxalate, according to the equation—

$$\frac{H_2O_2.\ \ H_2O_2.}{2C_2O_2 : 2C_2O_3 \frown 2C_2O_3} = 2C_2O_4 + \frac{H_2O_2.}{2C_2O_2 : 2H\,;\,2C_2O_3}.$$

Reverting again to the two cases proposed for analysis, I shall, in the first place, seek to interpret the molecular changes, which culminate in the production of the tartronate. A solution of the nitro-tartrate of water suffers decomposition even in the cold, the chief products being the tartronate, while carbonic acid and nitric oxide are evolved. The reaction is expressed by the equation—

$$\text{Nitro-tartrate, } \frac{2N_2O_5.\qquad 2N_2O_5.\ H_2O_2.\quad H_2O_2.}{2C_2\,;\,H_2O_2 \frown 2C_2\,;\,H_2O_2 : 2C_2O_3 \frown 2C_2O_3} =$$

$$= \text{tartronate, } \frac{H_2O_2.\ H_2O_2.\ \ H_2O_2.}{2C_2\,;\,H_2O_2 : 2C_2O_3 \frown 2C_2O_3} + 2C_2O_4 + 2(2N_2O_3),$$

and the accompanying molecular changes are thought to be as follows:—With the aid of 2 molecules of water, the nitro-tartrate resolves itself, in the first stage, into 2 molecules of nitrate and 1 molecule of tartrate. The latter soon splits up into carbonic acid and the monobasic glycerate—

$$\frac{H_2O_2.\qquad H_2O_2.\qquad H_2O_2.}{2C_2\,;\,H_2O_2 \frown 2C_2\,;\,H_2O_2 : 2H\,;\,2C_2O_3},$$

which speedily merges into the isomeric modification of the bibasic meta-glycerate—

$$\frac{H_2O_2.\qquad H_2O_2.\qquad H_2O_2.}{2C_2\,;\,H_2O_2 : 2H\,;\,2C_2O \frown 2H\,;\,2C_2O_3}.$$

By the oxidising action, first of one, and then of the other molecule of nitrate, the meta-glycerate is in the second stage made to pass into the meta water-salt—

$$\frac{H_2O_2.\qquad H_2O_2.\qquad H_2O_2.}{2C_2\,;\,H_2O_2 : 2H\,;\,2C_2O_3 \frown 2H\,;\,2C_2O_3},$$

and thence into the meta water-salt—

$$\frac{H_2O_2.\qquad H_2O_2.\qquad H_2O_2.}{2C_2\,;\,H_2O_2 : 2H\,;\,2C_2O_3 \frown 2H\,;\,2C_2O_5}.$$

The third stage is marked by the resolution of this latter into 2 molecules of water and the meta-anhydride—

$$\frac{H_2O_2.}{2C_2\,;\,H_2O_2 : 2H\,;\,2C_2O_4 \frown 2H\,;\,2C_2O_4},$$

which, by the method of orthogenesis, becomes finally converted into the isomeric tartronate, as formulated above.

I shall, in the second place, seek to interpret the molecular changes which culminate in the production of the malonate. When ordinary malate of water is treated with bichromate of potash and sulphate of water in the cold, the chief product is found to be the malonate, while carbonic acid is evolved. In this process, the malate is first of all oxidised into the tartrate, which soon splits up into carbonic acid and the glycerate. From this point the molecular changes are precisely as in the former case, except that, owing to the more scanty and sluggish supply of oxygen, the process terminates with the formation of the above-mentioned meta water-salt—

$$\frac{H_2O_2.\qquad H_2O_2.\qquad H_2O_2.}{2C_2\,;\,H_2O_2 \frown 2H\,;\,2C_2O_3 \frown 2H\,;\,2C_2O_3},$$

which becomes finally reduced to the state of malonate by the same kind of metamorphosis I have just shown to accompany the production of the tartronate.

Great theoretical importance attaches to the fact that, at a certain temperature, the malonate splits up into carbonic acid and the ordinary acetate; and the reader, by taking his cue from my analysis of kindred phenomena, will not be slow to perceive that the intermediate product must be the para-malonate—

$$\frac{H_2O_2.\ H_2O_2.}{2H_2C_2\,;\,2C_2O_3 : 2C_2O_3}.$$

The kind of metamorphosis here referred to, so far from being of an exceptional character, is, by the annexed scheme, shown to be a feature common to a whole series of homologues. The first member of the para-series, viz., the para-oxalate, is still unknown, but I consider it highly probable, that the so-called oxalovinate—

$$\frac{2H_4C_4\,;\,H_2O_2.\ H_2O_2.}{2C_2O_3 : 2C_2O_3},$$

is one of its ethylic ether derivatives. Under the influence of heat, this series of bibasic homologues is observed to give birth to a second series of monobasic homologues, which coincides in every respect with the series of the so-called fatty acids.

Having now presented the reader with a plain, intelligible, and, I trust, also correct analysis of the molecular changes, that accompany the natural production of the water-salts of succinic, malic, and tartaric acids in the living organism, I shall in the sequel endeavour to accomplish the analysis of the molecular changes, that accompany the artificial production of these compounds in our laboratories. The reader is, therefore, invited to ponder

TABLE OF GENETICALLY-RELATED WATER-SALTS OF THE FATTY ACIDS.

First Series of Acid Homologues.

Bibasic Water-Salts of the Fatty Acids.

Para-oxalate ..		$\frac{H_2O_2.\ H_2O_2.}{2C_2O_3\ ;\ 2C_2O_3} = 2C_2O_4 +$
Para-malonate ..		$\frac{H_2O_2.\ H_2O_2.}{2H_2C_2\ ;\ 2C_2O_3\ ;\ 2C_2O_3} = 2C_2O_4 +$
Para-succinate	*α*)	$\frac{H_2O_2.\ H_2O_2.}{2(H_4C_2 : C_2)\ ;\ 2C_2O_3\ ;\ 2C_2O_3} = 2C_2O_4 +$
	β)	$2H_4C_4\ ;$
Para-pyrotartrate	*α*)	$\frac{H_2O_2.\ H_2O_2.}{2(H_6C_4 : C_2)\ ;\ 2C_2O_3\ ;\ 2C_2O_3} = 2C_2O_4 +$
	β)	$2H_6C_6\ ;$

Second Series of Acid Homologues.

Monobasic Water-Salts of the Fatty Acids.

Formate		$\frac{H_2O_2.}{2H\ ;\ 2C_2O_3}.$
Acetate		$\frac{H_2O_2.}{2H_3C_2\ ;\ 2C_2O_3}.$
Propionate	*α*)	$\frac{H_2O_2.}{2(H_4C_2 : HC_2)\ ;\ 2C_2O_3}.$
	β)	$2H_5C_4\ ;$
Butyrate	*α*)	$\frac{H_2O_2.}{2(H_6C_4 : HC_2)\ ;\ 2C_2O_3}.$
	β)	$2H_7C_6\ ;$

the third part of my programme, where a fresh crop of valuable experimental evidence will be laid before him in support of the new views and doctrines I have ventured to promulgate.

(To be continued.)

ON THE ASH OF DISEASED POTATOES.

By ALEXANDER S. WILSON.

THE CHEMICAL NEWS, vol. xxvii., p. 147, contains an interesting paper, by Mr. J. B. Hannay, on the "Inorganic Constituents of Sound and Diseased Potatoes." From the analyses there given, Mr. Hannay concludes that the amounts of potassium, chlorine, and sulphuric acid are greater in diseased tubers than in sound ones, whilst the amount of soluble phosphoric acid is less.

The analyses admit of some other generalisations, but the author has either overlooked them, or they have been omitted in your report. On looking over a table of analyses of the ashes of potatoes, as given in some works on agriculture, one is struck with the great discrepancies between the different analyses; and when we attempt to compare the analyses of diseased samples with these, the task is one of difficulty, for we are at a loss with which to compare them; hence, doubtless, arose those differences of opinion as to the increase or decrease of potash in diseased roots, which Mr. Hannay notices, and which he has avoided by making analyses of good and bad samples taken from the same field.

Some time ago I made an analysis of the ash of a sample of diseased potatoes, which I dug, in the end of last season, from a plot of ground which was, I should say, favourably situated for the development of the disease, and consequently unfavourably for that of the potato. The soil in which these potatoes were grown consisted, for the most part, of disintegrated sandstone and decayed vegetable matters; the season, it will be remembered, was an excessively wet one. Unfortunately I was unable to obtain a sample of sound tubers from the same lot, and the leaves and stems were so far decayed that I did not consider them suitable for analysis. The potatoes were the kind known as "regents," and the tubers themselves were very much diseased, so much so that I question if they could have been used for feeding cattle.

One source of discrepancy in analyses of this kind must be noticed. This is the earth, which adheres tenaciously to the tubers, particularly in the eyes, even of sound potatoes, and penetrates into the substance of the diseased tubers in such a way that its separation can only be effected by cutting away the part. In this way a large portion of the cuticle is removed; now, the cuticle differs considerably in composition from the rest of the root, and from this cause considerable errors may creep into results, even although all the earth may have been removed from the sample. In preparing this sample I carefully removed the earth from the exterior, and cut out those parts where the sand was so much mixed up with the diseased substance as to render this impossible. A large quantity of the sample thus treated gave 1·07 per cent of mineral matter, which had the following composition:—

Potassium	44·51
Sodium	0·25
Magnesium	2·36
Calcium	1·12
Phosphoric anhydride	14·48
Sulphuric anhydride	5·57
Carbonic anhydride	15·80
Chlorine	1·37
Ferric oxide	0·53
Silica	2·89
Oxygen, equivalent to K, Na, Mg, and Ca, *minus* equivalent proportion of Cl	11·22
	100·10

On comparing these results with Mr. Hannay's, and with a number of analyses of sound tubers, I find that, so far as increase of potash and sulphuric acid are concerned, they confirm his conclusions; and, if they do not show that the phosphoric acid does not decrease, they at least show that some diseased tubers contain as much as some sound ones do; the chlorine, too, in this sample is less than in Mr. Hannay's sound sample. But what I wish particularly to direct attention to, is the small amount of lime and magnesia which the sample contains; in none of the analyses which I have consulted are the percentages so low as in this sample. Different observers state the percentage of magnesia in the ash of sound tubers at from 5 to 10 per cent; in this case it is only 3·94 per cent. In the two samples of diseased ash, Mr. Hannay only found 1·00 and 0·1 per cent of magnesia. Similarly, Mr. Hannay's, as well as my own, results show that the amount of lime is abnormally low in the diseased samples. In this case I found 1·77 per cent of lime; in the sound sample Mr. Hannay found 5·19 per cent, and considerably less in both the diseased samples. With regard to the sound sample, however, it may be observed that even, although these tubers were sound—that is, although they had not been attacked by the fungus,—still the vitality of these plants must have been considerably reduced by the unpropitious weather of last year, so as to render them liable to succumb on the deposition of the spores of the fungus on their stomata. This want of vitality may fairly be conceived as due to the presence of noxious, or the absence of necessary, substances in the juices of the plant, and such conditions must undoubtedly be the counterpart of the unfavourable circumstances under which the potato has laboured in many parts of the country, and in some years to a greater extent than in others. The potato plant is in every part of its structure strikingly adapted for a dry climate and light soil. When we consider that it has for many years been cultivated under the very reverse of these conditions, and that its structure has not varied to accommodate it to the changed circumstances, we cannot wonder that it has fallen the prey of its enemies.

With these considerations before us, I think that we

are justified in appealing to chemical science—to solve the problem as to the prevention of the disease—to suggest not a substance that will destroy the enemy, for this is next to impossible, but to give the plant such nourishment that will enable it to resist the adverse circumstances in which it is placed, as well as the attacks of its own peculiar enemies.

Some years ago, Professor Thorpe found, from the analyses of diseased and healthy orange trees, that, in the former, the amounts of lime and magnesia are deficient; the same thing, we have seen, is the case in the diseased potato plant.

It has lately been shown, by Dr. F. Crace Calvert, that lime is one of the few substances which we know that are capable of altogether preventing the development of fungi in organic solutions. He does not give any experiments relating to the action of caustic magnesia on fungi, but doubtless its action will be found to be similar.

Here, then, is a curious and, at the same time, significant fact—Diseased potatoes are deficient in lime salts: lime prevents the development of fungi. May not the development of fungi in the vessels of plants be furthered by this deficiency? The circumstances are such as scarcely to leave room for doubt. So far, then, theory and practice agree; lime has been found by experience to be useful in preventing the disease, and I cannot doubt that magnesia, if tried, will be found to have a similar effect.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 80.)

Lecture III.

On the Energy of Vitality, with especial reference to the Measurement and Utilisation of it.

The "Energy of Vitality" is a manifestation by motion of the unknown and unseen power which is associated with life—indeed that which may (perhaps) be said to constitute life itself. This vital power (some may call it force) is presented to our notice in two forms, the animal and the vegetable; hence the two sciences of zoology and botany.

In the distinctions laid down in the classification diagram, it will be observed that the energies are divided into potential and kinetic.

In seeds, in eggs, in frozen toads, in suspended animation, in hybernating animals, are examples of the potential energy of vitality. The power is there, but it awaits those surroundings which may convert this potential or dormant energy into kinetic or active energy. So long as a living body lives, it possesses kinetic energy; it has power to move. Such a power is not possessed by any dead body, although from external sources it may be introduced into one.

The energy of vitality is converted into the energy of affinity in the assimilation of food, into that of electricity in muscles and muscular action, into that of light as in glow-worms and certain fishes, and into that of heat as in warmth of the body. One peculiarity of this vital power is the ability to seize on that which is material, and to adapt or select therefrom whatever may be suited for its special purpose. The earliest or most elementary of the animal forms in which this vital power of adaptation displays itself is called a protoplasmic germ. This germ, or, as it may be described, this microscopical cell, if placed in congenial surroundings, manifests an energy of growth or reproduction which adapts these surroundings in a way and under an influencing power quite unknown to us. The power of gravity enclasps all matter, the power of vitality exercises a selectiveness from matter: gravity influences all matter, but changes the shape of none; vitality changes the form of all its influences. For example: the process of fermentation is one in which a minute molecule possessed of a vital power can communicate a similar power to another molecule, this again to another, in each case appropriating or attaching the molecule to itself for awhile, and so producing a rapidity of what we call growth, which seems almost as a process of crystallisation when the water of solution is being evaporated.

Between the development of a crystal, however, and of life, there is this marked difference. A crystal grows by appropriating *like* molecules, and deals with them according to laws unknown to us; a body having vitality not only appropriates various molecules, but re-combines, re-forms, and rejects. These the crystal cannot do. The growth of a crystal is a phenomenon in physics, the growth of an animal is a phenomenon in chemistry, In both cases, the powers of reproduction or enlargement are mysterious. Although under the influence of vitality many forms of matter are produced, yet the crystalline one never appears; as soon, however, as the excretory processes is completed, or the vital power is withdrawn, then commences work of a crystalline character.

How vitality is transfetred, or what it is, or in what contained, how nourished, or how destroyed, we know not. With the energy of vitality, as manifested in the processes of reproduction and growth, we are not this evening required to deal. Within that frame thus mysteriously developed, there are combinations of mechanical and chemical apparatus fulfilling conditions with which we are deeply concerned. This apparatus, however, does not from year to year retain the same power. Owing to the vital action, the apparatus with which we are to deal, whilst in incessant fluctuating change, yet attains a climax, then slowly subsides, then follows that phenomenon, even more mysterious, if possible, than any other of the vital ones, viz., their sudden cessation, which we call death. Neither in its earliest development nor in its mysterious cessation are those phenomena presented which are consequent upon energies we can either measure or utilise. Whence that comes which imparts vital energy, and whither it goes, are problems rather for human faith than human understanding. When an engineer has to estimate the power of a steam-engine, he does not ask of its early formation and past biography, nor does he speculate upon its future uselessness; he regards it as he finds it. So with animal vitality. We have to regard the animal as an engine, and in lieu of steam we have vitality. The engine is constructed so as to be utilised by the power of vitality, as that other engine is by the power of heat. Animals are much more economical engines than any man has made. The Creator's work is still far in advance of the work of the creature. Count Rumford showed that the amount of work done by a horse is much greater than could be obtained by employing its food as fuel for a steam-engine.

Note, also, what an economical conserving of energy there is in hybernating animals, which store up in summer that which they expend in winter in maintaining animal heat. To those who intend to offer the results of their ingenuity in the economising of fuel for the gold medals and £50 prizes offered by this Society, in December next, may be commended for especial study this property of hybernating animals. Your lecturer has no authority to make the statement, but he can with some confidence assure them that, if successful in teaching us to economise fuel as they do, they will win not only the prizes of the Society, but also the thanks of the nation.

An animal body is, indeed, a wonderful self-acting and self-regulating machine. It is a structure composed of movable parts, yet firm, and at the same time locomotive. Its hinges are well fitted with self-acting lubricators; its furnace supplies itself with fuel,

* The Cantor Lectures, delivered before the Society of Arts.

and can regulate the supply to the demand; its telegraphic communications are extensive, rapid, and need no superintendence; in its laboratory are performed experiments in the very highest departments of organic chemistry.

There are two forms of vital energy which have so much of a kinetic character that we may utilise them. Indeed, one form is self-utilised; vitality seems to have engaged its exclusive services, and whether the animal be waking or sleeping, vitality claims *all those* services from the machinery of the body which are rendered in the circulation of the blood, the digestion of the food, the operation of breathing, the propelling action of the heart. These are all motions resulting from some impressed laws, which have hitherto been hidden from our powers of research. That they continue, and that we are unconscious of them; that we cannot stop them, and even if we could by any means measure them, that we could not transfer them to any other purpose is clear without demonstration.

Therefore, since for scientific physiology the study of this form of vital energy is of paramount importance, it very naturally and properly would rank as one of the chief subjects for medical students. Indeed, the minds of physicians are necessarily often guided by circumstances to meditate upon its operation, and they are called upon to accelerate its action here and to retard it elsewhere. Hence the observant anatomist becomes, if not a kinetic, at least a static mechanician; the thoughtful physician reflects and harmonises the external evidences of these internal energies, and combining the events which fall under his notice, he deduces conclusions which link the laws of vital energies in their operations with those of the other imponderable influences which pervade all the universe.

Under such circumstances as these, Dr. Mayer, of Heilbron, in Germany, was led to conclusions in respect to the relations between heat and work which the further investigations of others by very different processes—processes in which the energy of vitality does not enter—have established as correct.

There is another form of vital energy similar to this over which we have control, and which we employ as we please within the limits which the vital power and the construction of the apparatus through which it acts permit. This is that to which we usually give the name of "muscular energy."

The qualifying words "within the limits" are essential, for the limit is in each case a hard and fast line, and we cannot overstep it. This limit is, perhaps, more admirably arranged in the animal frame than in any construction of man's devising. Although there are hundreds of muscles, yet their names, shapes, and businesses are very varied. Throughout all these changes one remarkable principle applies: every muscle is exactly adapted to the work it is likely to be called upon to perform.

There is a principle in mathematical science called the "Principle of least action." It may be explained thus—Given an object to be accomplished, then "the principle of least action" should teach how, with the smallest quantity of material and with the least expenditure of power, that object would be done. The more the muscular system is examined under this guidance, the more we are lost in wonder how exactly every portion of the body is suited for its specific work, and for the amount of work it is likely to be called upon to discharge, and more curious still, how (in special cases) the muscle may develop in order to meet certain requirements, as, for example, the muscles in the arms of a smith, as well as other muscles. And, further, how perfectly these muscles are varied in form and construction so as to meet the requirements of their respective occupations, and, if called upon by prospective emergencies, to be ready for more than ordinary exertion. Certain muscles are so prepared for extraordinary exertion, and then relapse into their normal state, thus strictly carrying out the "principle of least action."

(To be continued).

NOTES ON THE

DETERMINATION OF TITANIC ACID IN TITANIFEROUS IRON ORES, ETC.

By WILLIAM BETTEL.

I TRUST the following modification of Mr. David Forbes's process ("Select Methods in Chemical Analysis," pp. 110 to 111) for the estimation of titanic acid, may not be unacceptable to those engaged in the analysis of titanic ores:—

Fuse about 0·5 grm. of the *finely* powdered ore with 6 grms. of pure bisulphate of potash (which has been recently fused and powdered) in a platinum crucible at a gentle heat, carefully increased to redness, and continued till the mass is in tranquil fusion.

Remove from the source of heat, *allow to cool*, digest for some hours in 5 or 6 ozs. of cold distilled water—not *more* than 10 ozs. is to be used, as it generally causes a precipitation of some TiO_2—filter off from a little pure white silica, dilute to 45 or 50 ozs., *add sulphurous acid until all the iron is reduced*, then boil for six hours, replacing the water as it evaporates.

The titanic acid is precipitated as a *white* powder, which is now to be filtered off, washed by decantation, a little sulphuric acid being added to the wash-water to prevent it carrying away TiO_2 in suspension. Dry, ignite, allow to cool, moisten with solution of ammonic carbonate, re-ignite, and weigh. The titanic acid is invariably obtained as a white powder with a faint yellow tinge, if the process has been properly carried out.

I find the method of fusing with bisulphate of potash ("Select Methods," p. 125) to be preferable to all others for decomposing difficultly soluble iron ores.

Borough Laboratory,
84, Milton Street, Middlesbro',
August 12, 1873.

CORRESPONDENCE.

AMMONIA TEST FOR DRINKING-WATER.

To the Editor of the Chemical News.

SIR,—The importance of the ammonia test for drinking-water, and the extensive use now made of it, render it desirable that it should be as accurate and as easy of application as possible. In common with others, we have had great trouble in using it, in consequence of the slowness and uncertainty of the Nessler reaction.

In a recent letter, Mr. Wanklyn attributes this to the manner of preparing the Nessler solution, chiefly to the neglect of the addition of mercurial solution at the end of the process. Alhough this may be the cause in some cases, it is certainly not so in all, and I desire to point out a source of difficulty which appears to have been hitherto overlooked; this is the presence of *carbonic acid* in the liquid to be tested. In a distillate, unless it has been exposed to the air for some time, this is not likely to occur, and accordingly I have frequently found a sharp reaction in the distillate, but no reaction in the comparison liquid until after a preposterously large quantity of the ammonium chloride solution had been added, or until a very long time had elapsed. Recently, examining the distilled water which gave this result, I found in each instance that there was a considerable quantity of carbonic acid present, and that, by taking fresh distilled water free from carbonic acid, a sharp and immediate reaction was obtainable. Similarly, if there be carbonic acid in the distilled water with which the ammonium chloride solution is made, there will be delay in the reaction.

The explanation is, that the carbonate, as well as other salts of ammonia, will give a reaction with Nessler's solution in extremely small quantity, but the addition of

an excess of carbonate or carbonic acid alone will redissolve the precipitate, or discharge the colour of the liquid.—I am, &c.,

F. DE CHAUMONT, M.D., Surgeon-Major.

Laboratory, Army Medical School,
Royal Victoria Hospital, Netley,
August 19, 1873.

NOTICES OF BOOKS.

Half-Yearly Compendium of Medical Science. Part IX., January, 1872. Philadelphia: S. W. Butler.

THIS conpendium takes a wider scope than its English contemporary, Braithwaite's "Retrospect," and contains a large and varied amount of important matter, selected from European as well as from American authorities. If we do not quote any of its chemical notes, it is merely on account of their dating nearly two years ago, and having consequently been brought before the public through other channels. We are particularly struck with an article on the "Pathological Effects of the East Wind," which, though not coming within our ordinary scope, is profoundly suggestive, and may, perhaps, offer the key to many unsolved questions, psychological and social as well as pathological.

We notice a feature in the paging of the book which may be worth imitation in works of a similar nature. The running page of each number is at the bottom, whilst each department is paged independently at the top. Thus the work when bound resolves itself into a number of separate volumes on "Materia Medica and Therapeutics," "Clinical Medicine," &c. In the table of contents, the names of American authors are given in small capitals, those of foreign authors in Italics.

Proceedings of the American Pharmaceutical Association at the Twentieth Annual Meeting, held in Cleveland, Ohio, September, 1872. Philadelphia: Sherman and Co.

THESE "Proceedings" contain both scientific matter and important papers bearing on the drug trade, and on the status and prospects of the pharmaceutical profession in the United States. The organisation of the Association appears to us complete and efficient. There are standing committees on the drug market, on the progress of pharmacy, on adulteration and sophistication, on legislation, on infringement of stamp tax, and on a variety of other matters of importance to the profession.

Many of the papers read, though not of a character coming within the ordinary scope of our cognisance, strike us as being exceedingly valuable. Prof. Moore's strictures on certain "commercial elixirs," as being merely a fashionable way of getting stimulants into the stomachs of women and children, are quite applicable on this side of the Atlantic.

There is a lengthy paper on the manufacture of glass as applied to the make of bottles for containing chemicals. None of the forms of stopper suggested equal, in our opinion, the mushroom pattern, in which the stopper, properly so-called, terminates in a cap, concave downwards, so as entirely to protect the lip from dust. The absurdity of putting articles easily acted on by light is denounced, and a canary-yellow shade, producible by uranium, is shown to be much superior for such preparations, as cutting off the so-called chemicals rays of light.

There is some discussion on insects capable of acting as substitutes for cantharides. Here we must protest against the unscientific custom of applying the term "bug" to coleopterous insects or beetles, an error as great as the Cockneyism of calling the cockroach a blackbeetle.

There are well-grounded complaints on the increasing prices of drugs and chemicals, aggravated in America by a scale of import duties almost as vexatious as those under which our grandfathers laboured in the good old days of the younger Pitt. It is doubtless a mark of great liberality on the part of Congress that indium is admitted duty free.

We are glad to find that the efforts of American pharmacists for securing a higher educational standard in their body, and for excluding incompetent persons from the profession, are seconded by public opinion and by the legislature.

A paper on the analysis of glacial phosphoric acid of commerce shows that many samples contain as much as 10·7 per cent of soda. Arsenic in minute traces was found only in one sample.

An appendix treats of the weather observations and the storm-signal service in the United States.

We cannot conclude this brief notice without expressing our cordial sympathy with the American pharmacists in their efforts for the organisation of their profession and for the elevation of its status.

A Compendious Manual of Qualitative Chemical Analysis. By C. W. ELIOT and F. H. STORER. Revised by WM. R. NICHOLS, Professor of General Chemistry in the Massachusetts Institute of Technology. Second revised edition. New York: D. Van Nostrand.

MANUALS of chemical analysis, especially qualitative, have a strong family likeness, and their increasing number renders it difficult to say which we should prefer. In the work before us there is little to which we can object. The usual tests and the precautions to be observed in their application are carefully and clearly described.

It strikes us, however, as rather strange that of the known metallic elements twenty-two only are taken into consideration. Those omitted cannot be, as a class, pronounced either rare or unimportant. Some of them are of frequent occurrence both in natural minerals and in manufacturing products and residues. They are capable of modifying or simulating characteristic reactions, and of interfering with industrial processes. Some of them—we may instance uranium and tungsten—have their practical applications. On these grounds we are led to doubt whether their sweeping exclusion from elementary analytical manuals is altogether judicious. We would not certainly plunge the beginner into the niceties requisite for recognising the various members of the cerium group, but we submit that Messrs. Eliot, Storer, and Nichols have fallen into the opposite extreme.

Turning to the instructions given for the detection of phosphoric acid, we find it stated that the molybdate of ammonia test "can be used in presence of arsenic acid." Neither is there any caution given as regards the presence of silicic acid in the substance under examination. Yet the highest authorities have shown that both arsenic and silicic acids form, with molybdic acid, precipitates similar to that yielded by phosphoric acid under the same circumstances, and have therefore insisted on the elimination of the two former bodies as a necessary preliminary to the use of the molybdic test. It is perfectly true that the addition of a few drops of a solution of arsenic acid or of a soluble arseniate to the molybdic test-liquor does not cause, in the cold, the immediate formation of a yellow precipitate. But neither is it safe to infer the absence of phosphoric acid if a precipitate is not at once formed in a cold solution. Either prolonged standing or digestion at a gentle heat is necessary if the amount of phosphoric acid is minute. We are, therefore, compelled to pronounce this paragraph as unsatisfactory, and to suggest to the editor the propriety of its revision.

The formula given for the "magnesia" mixture used in the detection and estimation of phosphoric acid appears preferable to that of Fresenius, as being less likely to cause the precipitation of magnesian hydrate.

The appendix contains directions for the preparation of the necessary reagents, a list of apparatus, and some brief

but valuable notes on manipulation. We quote the following passage :—"Whenever a reagent is to be used, the bottle which contains it should be grasped in the right hand; the stopper should be taken out by pinching it between the first (thumb) and second or third and fourth finger of the left hand, or by pressing it between the little finger and the palm of that hand. In either case the bottle is withdrawn from the stopper, not the stopper from the bottle. Neither bottle nor stopper should be put upon the table; the stopper should be held in the left hand as long as the bottle is open. When the reagent has been poured out the bottle is immediately closed and returned to its place upon the shelves. If these apparently trifling particulars are scrupulously attended to, no stopper can ever be misplaced or soiled by contact with liquids or dirt on the table. Moreover, the label on the bottle cannot be injured by drops of the reagent, since the liquid must necessarily be poured from the back or blank side of the bottle." If students trained in such principles do not become sound, accurate chemists, the fault will be their own.

MISCELLANEOUS.

Public Analyst for Salford.—At a meeting of the Salford Town Council, held at the Town Hall, Salford, on the 6th inst., Mr. Alderman Davies moved: "That the Council be recommended to appoint Mr. Joseph Carter Bell, F.C.S., to be public analyst for the borough, and that his remuneration be by fees or allowances, as provided by the Adulteration of Food, Drugs, &c., Act, 1872, such appointment to be terminable by three months' notice in writing from either party." He said that, according to the Act of Parliament, the minimum fee of the public analyst would be 2s. 6d., while the maximum fee would be 10s. On the appointment of Dr. Tatham as medical officer of the borough, it was thought that he would undertake the duties of public analyst, but Dr. Tatham had found that his time was fully occupied with his own duties, and had expressed himself unwilling to undertake the office of public analyst. Mr. Alderman McKerrow, in seconding the motion, said he considered the Council had been fortunate in obtaining the services of Mr. Bell, as there were few gentlemen of his qualifications who would accept the appointment without a fixed salary. The motion was passed.

Impure Water.—At a recent meeting of the Chemico-Agricultural Society of Ulster, Dr. Hodges reported the results of several analyses of the water of springs. He said that the composition of the water supplied in the districts surrounding Belfast continued to receive attention from him, and in consequence of his representations much improvement had been effected, and the use of some waters which he had found largely contaminated with sewage impurities had been abandoned. This inquiry at the present time was of especial importance. In several cases the outbreak of fever was the first thing which attracted attention to the impurity of the water used. He had formerly reported that the water supplied to the District Lunatic Asylum at Downpatrick had become polluted by sewage matters, derived from sewers which passed near the well. This cause of danger to the inmates of the establishment had now been removed; and lately he had the satisfaction of reporting that the water now supplied was of very superior quality. A water, Dr. Hodges stated, may be turbid, and deposit a sediment on standing, and be free from sewage impurities. Thus, occasionally the town water was turbid, like all waters from districts abounding in peat; but this impurity did not appear to exercise any effect injurious to health. It should, however, be removed by a more perfect system of filtration than that at present in use. Nitrogenous impurities are, however, very different from those derived from peat and soils rich in vegetable matters, and the presence in a water of a large amount of ammonia or of albumenoid ammonia is always to be regarded as significant of danger. It is true that the large extent of land drained by streams must, in many cases, convey to the rivers from which the water supply is frequently derived, refuse matters containing nitrogenous matter in various forms, even when no sewage matter is present. But this pollution may become a cause of disease, and when wells or streams are situated in the midst of a dense population, the nitrogenous matters carried into them are especially dangerous, and their amount is usually regarded as a measure of the quality of the water and its suitability for domestic use. As an illustration of the power which we possess of preventing disease, the valuable report of Surgeon-Major De Renzy, "On the Extinction of Fever in the Millbank Prison by the Disuse of Thames Water," is most instructive, and deserves the careful consideration of the public bodies in this and other towns. It appears that the convicts in the prison previous to 1822 had been subject to an intestinal flux, which the medical officer supposed to be due to over-feeding and insufficient exercise. The dietary was altered; yet three months after an epidemic of dysentery, diarrhœa, and fever, accompanied with scurvy, began, affecting 500 convicts out of the 880 confined. In 1832 the prison suffered severely from cholera, and then some subsequent severe visitations of dysentery, fever, and cholera. The opinions of the leading scientific men of the metropolis were obtained, and means for securing ventilation, &c., were tried, but without effect. In the years from 1845 to 1854 there were 57 deaths from typhoid. The water supply was changed in August, 1854. Up to that date the water used was taken from the Thames, as it flows by the prison, purified by filtration. The new supply was from an artesian well in Trafalgar Square. It was during the severe epidemic of cholera, and there were cases of cholera in the prison at the time. Six days after the change the disease suddenly ceased, and a marked improvement took place in the health of the prison. From that period up to April, 1872, a period of nearly nineteen years, there have been only three deaths from typhoid, viz., one in 1855, one in 1860, and one in 1865. Of these, the last occurred in a convict who was suffering from the disease at the time of his admission. In the first part of 1854, and before the change of water supply, there had been three deaths from fever and two from diarrhœa. In the nineteen years since the change of supply there has been only one death from these diseases, and this change occurred while in all other respects the sanitary condition of the prison remained unaltered. As an instance of the extent to which the wells in the country may become defiled by sewage matter, Dr. Hodges gave the following analysis of water from a well at Larchfield, near Hillsborough, which had been examined for a member of the Society :—

An imperial gallon contained—	
Total solid matters	35·0 grs.
Consisting of—	
Mineral and saline matters	22·4 ,,
Organic and volatile matters ..	12·6 ,,
Chlorine, equal to $6\frac{1}{10}$ grs. of common salt per gallon.	
One million parts contained—	
Free ammonia	0·02 part.
Albumenoid ammonia	0·30 ,,

Water Supplied from Calcutta Hydrants.—In his report on the water supplied from the Calcutta hydrants during the year 1872, Dr. F. N. Macnamara says:—"Transparency has been determined by the examination of a column of water in a 2-foot tube. It was found defective on seventy days, as against eighty-six days of last year when such imperfection was noticed. Defective transparency is in the case of this water always due to the presence of very minutely divided clayey matter. This is the same stuff which is so largely present in the river-water during the rains, and is in a so finely divided state,

and is so light, that the water must be allowed to stand for at least four or five days before it clears by subsidence—filtration through several folds of filtering-paper does not remove the cloudiness. On some occasions the cloudiness became apparent in a very sudden and marked way, and was then accompanied by an increase in the organic matter dissolved in the water, but on other occasions a faint cloudiness of the water was not associated with increase of organic matter. This is a point which was particularly attended to, as there has been dispute regarding it amongst observers in England, amongst whom some have held that access of cloudiness to the water must necessarily be accompanied by an increase of organic matter. I have, however, satisfied myself that this view is an erroneous one, and that loss of transparency is not necessarily accompanied by any determinable addition to the organic matter in the filtered water. *Chlorine, Determined in the Water without Evaporation in the usual way with Solution of Nitrate of Silver, and Chromate of Potash as Indicator.*—On no day during the year has there been such increase in the quantity of the chlorine in the water as to lead to suspicion of tidal water being pumped into the reservoirs at Pultah. The largest quantity of chlorine found in the water was in the first week in May, when it reached 9·2 parts per million (equal to 1·06 grs. of chloride of sodium per gallon). The smallest quantity found was in November, when it fell to 3·9 parts per million. *Organic Matter.*—The organic matter was present in small quantity in the filtered water till the middle of September, when a great and sudden increase occurred, and the amount of organic matter continued large till the end of November, at which time it slightly diminished, and since then, up till January 31st, there has been but little, if any, improvement in the water. This is a point on which I wish to lay great stress, as in respect to it the past season contrasts most unfavourably with the corresponding one of the previous year, for about the middle of November, 1871, the water became exceedingly pure, and continued so till the end of August, 1872. Why did not a corresponding improvement occur on the termination of the past rains? I am assured that there has been no change at the works, that the processes of subsidence and filtration have been carried on in a precisely similar manner both years, while comparison of the analyses of the river-water show that it had the same characters both years during the season under consideration. There has been, indeed, more demand upon the filters in 1872 than in 1871, for, while in round numbers 49,000,000 gallons passed the filters one year, the quantity rose to 61,000,000 gallons during the next; there must therefore have more rapid filtration, and this, however brought about, must have tended to the deterioration of the water. Further, it seems to me probable that, owing to this stress put upon the filters, especially during the season of flood-water in the river, the suspended organic matter may have penetrated them farther than last year, and may be decomposing in them and adding to the soluble impurity of the water. Moreover, the condition of the settling-tanks is such that they must maintain a considerable degree of impurity in the water. Great as is the advantage in some respects of these tanks, absolutely essential as is the separation of silt which they effect to the mechanical action of the filters, there can be no doubt that they serve as reservoirs which catch and hold an immense quantity of filth, which decomposes in them, and is by-and-bye given up to the water, so that the comparatively pure water of the river after the subsidence of the floods is fouled by the stuff which has been deposited in the tanks during the preceding months. But possibly another cause is at work in maintaining the impurity, and I find it in this way. Experiments made in 1871, and recorded in the last annual report, established the fact that the water, after leaving the well at Pultah, purified itself very much prior to its distribution in Calcutta, losing about one-half its organic matter, but experiments made lately show that nothing of the kind is occurring now, and that the water as distributed in Calcutta contains little, if any, less organic matter than the water before it commences its downward journey. Possibly the flow—about 13 miles in a 42-inch iron main to the Tallah reservoir, and about 3 miles of 30-inch main from Tallah to Wellington Square—may be more rapid this year than last, and this may account in a measure for the difference I have alluded to, but I suspect that the real explanation lies in an accumulation of dirt, either in the main, or in the reservoirs at Tallah or in Wellington Square (this has been discovered at the Tallah pumping-station), which has been yielding up organic matter to the water, and thus counteracting the purification which the water should naturally experience as it flows from Pultah to Calcutta. During August the solid matter in the water was reduced by the operation of the works to one-tenth the quantity present in the water of the river, while the organic matter was reduced to one-sixth, and it was only when the accumulation of silt upon the surface of the filter beds rendered the operations of raking the sand or removal of the surface sand necessary, that the filters became less effective. On two occasions during August and October water was drawn for examination at the same hour on the same day from six hydrants in different parts of the town. The amount of organic matter and of chlorine in the water was found absolutely the same in each sample, proving also the excellency of the processes employed, for it is simply impossible that variations in the quality of the water, and in the accuracy of the manipulations, should have balanced in each case so as to yield the results obtained; I think that there is no accumulation of dirt in the street-mains, and that there is no diffusion of dirty water from the soil into them."

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the treatment of sewage, and of the deposits obtained therefrom. Major-General Henry Young Darracott Scott, C.B., Ealing, Middlesex. January 14, 1873.—No. 154. I precipitate the sewage water with quick-lime in excess in tank No. 1. The precipitate thus produced is allowed to subside, and to the effluent therefrom I add soluble salts of cheap metallic oxides, such as the oxides of iron or zinc, in sufficient quantity to precipitate in tanks No. 2 the bases of such salts.

Improvements in treating excreta and sewage matters, and in apparatus employed therein, parts of the apparatus being also applicable to the drying and charring of other matters. John Lewis Felix Target, civil engineer, Portsdown Road, Middlesex. January 15, 1873.—No. 168. According to this provisional specification, the solid excreta are mixed with a nearly equal weight of charcoal, and about 4 per cent of coal-tar or bituminous substance. The mixture is made into blocks or bricks, which, after being dried, are burnt or charred in a muffle-furnace. The vapours and volatile bodies given off from the bricks become ignited, and the products of combustion are conducted by a flue to heat the boilers of a still or other apparatus in which the urine is treated. This utilisation, for treating the urine, of the heat given off during or previous to the conversion of the solid excreta into charcoal is an important feature of the invention. The charcoal produced by the burning of the mixture of solid excreta and other substances may be subsequently used as fuel or otherwise. Improved drying houses, muffle-furnaces, distilling apparatus, and other necessary parts are described.

Improved means or arrangements for filling or feeding lamps with liquid fuel, applicable also to the filling or feeding of other apparatus used for burning such fuel. Johann Maximilian Plessner, 11, Golden Square, Middlesex. January 16, 1873.—No. 180. This invention comprises a can or receptacle for the paraffin or oil or liquid fuel, provided with injecting mechanism or other means whereby, through the agency of a tube, the paraffin or oil or fuel can be introduced into the body of the lamp (by a suitable opening therein) without interference with the wick or allowing the paraffin or oil or liquid fuel to be exposed to the action of the air.

Improvements in the purification of coal-gas. Major-General Henry Young Darracott Scott, C.B., Ealing, Middlesex. January 16, 1873.—No. 183. The object of this invention is the removal of sulphur from coal-gas by means of oxide of iron heated to redness in a suitable chamber.

An improved pavement. Robert MacNeill, Lombard Street, London. January 16, 1873.—No. 184. My said invention relates to a pavement which has a foundation of asphalt or other bituminous or tarry substance or compound, and an upper structure or surface of blocks or other suitable material.

SUPPLEMENT
TO
THE CHEMICAL NEWS.
VOL. XXVII. No. 717.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, July 28, 1873.

New Process for the Condensation of Liquefiable Matters Held in Suspension in Gases.—E. Pelouze and P. Audouin.—The authors point to the existence of tarry matters, ammoniacal water, &c., which are held in suspension in coal-gas as it issues from the retorts, and which cannot be made to deposit even at low temperatures without the aid of costly bulky apparatus. They propose a new method of condensation, which has been already practically tested, founded on the principle that the liquefaction of the globules held in suspension in gases may be obtained either by the contact of these particles with solid surfaces, or by their contact with each other. They obtained the condensation of liquids suspended in gases or vapours by the aid of a very simple apparatus, occupying little space. The gas to be purified passes by a series of narrow apertures in the form of jets, which spread themselves over a surface placed opposite. This arrangement produces a mutual contact of the molecules during their passage through the jets, the efficacy of the action being completed by the contact with the solid surface over which the tarry matter flows. A very high pressure is not needed. The apparatus may be placed either before or behind the exhaustors. The temperature —about 50°—does not interfere with the working of the apparatus. The material may be iron, earthenware, or wood. By this arrangement ammonia, sulphide of hydrogen, and sulphide of carbon may be intercepted.

Respiration of Submerged Aquatic Vegetation.—P. Schützenberger and E. Quinquand.—The method used was titration with hydrosulphite of soda, by which oxygen dissolved in 50 c.c. of water can be determined to 0·005 c.c. or to 0·1 c.c. per litre. The plants experimented upon were beer-yeast and *Elodea canadensis*. Yeast simple absorbs oxygen and produces carbonic acid. All other things being equal the intensity of respiration was alike in the dark, in diffused light, and in direct sunshine. The absorbent power is nearly *nil* at 10°; up to 18° it increases slowly; from that point it grows rapidly to 35°, where it reaches a maximum which is maintained up to 50°. At 60° the absorptive power is destroyed. Fresh yeast, containing 26 per cent of solid matter, absorbed per gramme and per hour—at 9°, 0·14 c.c. of oxygen; at 11°, 0·42 c.c.; at 22°, 1·2 c.c.; at 33°, 2·1 c.c.; at 40°, 2·06 c.c.; at 50°, 2·4 c.c.; and at 60°, 0·0 c.c. *Elodea canadenis*, like all plants which develop chlorophyll, has a double respiration—(1) absorption of oxygen and production of carbonic acid; (2) development of oxygen under the influence of light. The plant on being heated in water to 45° to 50° entirely loses its power of liberating oxygen under the influence of light without its power of absorbing oxygen being affected. The latter phenomenon was found to continue in the light with the same intensity as in the dark; being the result of an independent vegetable function, parallel to the so-called diurnal respiration or disengagement of oxygen. The phenomena of absorption are similar to those displayed in the case of yeast, but about ten times less energetic. The following amounts of oxygen were liberated during one hour by 10 grms. of the plant:—

		c.c.
1.	In pure water	1·0
2.	Do. + 2·5 per cent of water saturated with CO_2	13·2
3.	Do. + 5·0 per cent water do.	20·0
4.	Do. + 20 to 30 per cent do.	13·0
5.	Do. + 40 per cent do.	10·0
6.	Water saturated with CO_2	3·0

On leaving an excess of the plant submerged in the sunlight for an hour or two we obtained a liquid supersaturated with oxygen, containing at 35° as much as 20 c.c. of oxygen per litre. This water, when removed from the plant, lost its excess of oxygen with remarkable slowness.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, July 28, 1873.

Action of Formiate of Soda upon Benzoic Acid.—F. v. Richter.—On fusion hydrogen is given off, and the carboxyl groups as they are set at liberty combine partly to form oxalic acid, and in part they act substitutionally. In presence of benzoate of potassa dicarbon acids are formed—

$$C_6H_5.CO_2R + HCO_2Na = C_6H_4 \begin{cases} CO_2K + H_2 \\ CO_2Na \end{cases}$$

Isomeric Series of the Benzol Derivatives.—V. v. Richter.—A theoretical paper. The author concludes that the constitution of the benzol derivatives is not so certainly established as many chemists assume.

New Constituent of Urine.—F. Baumstark.—The substance in question was found first in the urine of a dog fed with benzoïc acid, then in icteric, and finally in normal human urine. Its composition corresponds to the formula $C_3H_8N_2O$. It crystallises in white columns like those of hippuric acid, which melt at 250°, and if heated on platinum foil give off dense white vapours of a peculiar odour. If heated in a narrow tube they yield a combustible gas, which turns litmus blue and smells of ethylamin. The crystals are readily soluble in hot water, sparingly in cold water, insoluble in absolute alcohol and in ether. The new compound forms soluble salts with acids, and does not combine with bases; the solution is precipitated by the nitrate of silver. On treatment with nitrous acid, lactic acid—whose very soluble zinc salts contains 12·1 per cent of crystalline water: it is, therefore, the so-called lactic acid of flesh.

On Chrysin and its Haloid Derivatives.—J. Piccard.—Some years ago the author discovered chrysin—a well characterised yellow colouring matter in the buds of the poplar. (*Bolley's Schweitz. Polyt. Zeitschrift*, vol. ix., p. 137, 1864.) He now enters upon an examination of its properties and its combinations. Chrysin is composed of—

Carbon	70·86
Hydrogen	3·95
Oxygen	25·19
	100·00

corresponding to the formula $C_{15}H_{10}O_4$. The author has formed and examined its bromide, iodide, chloride, and nitro compounds, and considers it a homologue of alizarin and frangulinic acid.

Certain Constituents of Poplar Buds.—J. Piccard.—Along with chrysin the author has come upon three other

bodies—the ethereal oil of poplar, C_5H_8; a mixture of salicin, papulin, and tectochrysin, $C_{16}H_{12}O_4$, a higher homologue of chrysin.

Action of Perchloride of Phosphorus upon Pyruvic Acid.—C. Böttinger.—The reaction is violent; on its completion a clear pungent liquid passed over at about 55° to 60°; which, when mixed with alcohol, gave off an odour of acetic ether. Large quantities of C_2H_5Cl, and of carbonic acid are given off, whilst a dark coloured syrup remains behind containing Climenko's ether. The author appends a preliminary announcement of a new acid obtained from the pyruvic acid.

Chlorinated Derivatives of Aceton.—Albert Theegarten.—The author obtains dichloraceton by the action of chlorine upon aceton.

Hygroscopicity of the Monophosphate of Calcium.—K. Birnbaum.—The author finds that a portion of pure monophosphate, which—after being dried over sulphuric acid—weighed 1·339 grms. when exposed to the air of the laboratory and weighed daily fluctuated from 1·478 to 1·504 grms. If placed over water the weight rose in three days to 1·876; and on being again exposed freely to the air for three days it fell to 1·501. The same phenomenon, though on a smaller scale, may be observed with superphosphate. By the variable amount of water taken up the percentage of soluble phosphate will be made to fluctuate.

Action of Anhydrous Acetic Acid upon Rhodan-Ammonium.—M. Nencki and W. Leppert.—The authors obtained by this reaction the acid acetylic ether of the bibasic persulpho-cyanic acid—$C_2H(C_2H_3O)N_2S_3$.

On Benzyl-toluol.—M. Plaseuda and Th. Zincke.—By oxidising benzyl-toluol with bichromate of potassa and sulphuric acid, the authors obtain benzyl-benzoic acid, and an isomeric body to which they give the preliminary name β-benzol-benzoic acid. This acid crystallises from hot water, in which it is considerably more soluble than the α-acid, in long and broad needles, consisting of aggregations of prismatic crystals. Along with the acids were also formed a hydrocarbon and a keton.

Commercial and the Pure Isobutylic Aldehyd and Isobutylic Alcohol.—G. A. Barbaglia.—The author concludes that the isobutyl-aldehyd, obtained from the Kahlbaum Works (which he had employed in some previous experiments), contains large quantities of aceton, and that the isobutylic alcohol is contaminated with various foreign substances, probably with a considerable amount of isopropylic alcohol. Hitherto no industrial process is known for the preparation of pure isobutylic alcohol, and isobutylic aldehyd.

On Oil of Citron.—A. Oppenheim.—A hypothetical paper. The author pronounces American oil of turpentine and the oil of citron to be both hydromethyl-isopropyl-benzols of the para series.

Critique on the Methods for the Analysis of Water.—Ferd. Tiemann.—(Continuation.)—*Determination of Sulphuric Acid.*—(1). Gravimetric Method.—The amount of sulphuric acid in a natural water can be easily and accurately determined by precipitation with chloride of barium and weighing. The results of this process, which was once considered the most accurate of all gravimetric methods, may readily become inaccurate if the precipitation of the sulphuric acid is performed in a too concentrated solution, and if a too strong solution of chloride of barium be employed. The presence of large amounts of foreign matter, especially alkalies, nitrates, &c., has a disturbing influence, as portions of them are carried down with the precipitate. Finkener even declares that the precipitate is never a perfectly pure sulphate of baryta. In the case of a natural water, however, the circumstances are especially favourable. If the sulphuric acid is thrown down from the boiling water, slightly acidulated with hydrochloric acid, with a very dilute hot solution of baric chloride—using the further precaution to add first a little of the precipitant, and afterwards a not too large excess—and if the precipitate is allowed time to deposit without filtration, the results may be considered almost absolutely accurate. The only objection is the amount of time required; whence the following methods have been proposed by Weldenstein, and by Boutron and Boudet. Weldenstein precipitates the sulphuric acid by adding an excess of chloride of barium solution of a known strength, and titrating the excess with a neutral solution of chromate of potassa. As large amounts of carbonate of lime have a disturbing influence the water should be rendered acid at the beginning of the experiment, and neutralised again before the addition of the chromate. It is better to boil the water previously, and make it up to its original bulk with distilled water before the determination. The author finds that boiling does not cause the precipitation of sulphate of lime if the loss by evaporation is constantly approximately replaced by distilled water. There is, in Wildenstein's original method, a difficulty in finding the exact end of the reaction. To obviate this 100 c.c. of the water, previously boiled and made up to its original bulk, are heated to boiling in a flask marked at 150 c.c. and 10 c.c., or if much sulphuric acid is present, 15 to 20 c.c. of a solution of chloride of barium containing 1-10th of an equivalent per litre. After boiling for a few minutes, such a quantity of a corresponding solution of neutral chromate of potassa is added, that when the precipitate settles the supernatant liquid appears faintly but distinctly yellow. When the whole is cold, which is accelerated by setting the flask in cold water, the flask is filled up to the mark with distilled water, the contents shaken and filtered through an unmoistened filter. 100 c.c. of the filtrate are placed in a narrow cylinder of colourless glass, in which the liquid may stand at the depth of 15 to 20 centimetres. In a similar cylinder 100 c.c. of distilled water are then mixed with so much of the standard chromate solution that both exhibit the same tone of colour. The shades produced by 0·1 to 0·6 c.c. of the 1-10th chromate solution can be clearly distinguished. The amount of the chromate added in excess as thus ascertained, multiplied by $\frac{2}{3}$, is deducted from the amount of this solution which has been added to the water under examination. From the difference between the remaining c.c. of chromate, and the c.c. of chloride of barium consumed, the amount of sulphuric acid in the water is readily calculated. In Boutron and Boudet's method the sulphuric acid is thrown down from the boiled water—whose permanent hardness is known—by solution of baric chloride in excess, the value of which is adjusted to the soap liquor. The whole is filtered after the precipitate has settled, and the remaining hardness of the filtrate is determined by the soap-test. If to the "permanent hardness" of the water we add the degrees of hardness corresponding to the baric chloride solution added, and from the sum deduct the hardness of the filtrate, we obtain a value from which the amount of sulphuric acid in the water may be readily calculated. The author proposes the following modification of this method:—100 c.c. of the water previously boiled are heated to boiling in a flask marked at 150 c.c., and mixed in slight excess with a solution of baric chloride, every c.c. of which corresponds to a German degree of hardness. After the precipitate has settled, and the liquid has cooled, the flask is filled up to the mark with distilled water filtered through an unmoistened filter, and the residual hardness is determined in 100 c.c. of the filtrate. In connection with the determination of sulphuric acid the author adds some observations which he has made on grouping together the figures found in the analysis of waters. The permanent hardness of the water, its percentage of sulphuric acid, chlorine, nitric acid, alkalies, and ammonia are here brought into question. In drawing out the results of an analysis of water it is customary to assign the chloride to the alkalies; the remainder of which are calculated as sulphates, whilst the excess of sulphuric acid is allotted to lime and magnesia, as also

the residue of the nitric acid after the ammonia is satisfied. This arrangement is by no means satisfactory with the subsoil waters of populous places. If the supposition on which the above-mentioned arrangements are founded were correct, the total amount of the fixed bases, and the ammonia which is required to saturate the sulphuric, hydrochloric, and nitric acids present, would stand in a definite relation to the ascertained permanent hardness of the water. If we consider the well-known fact that the bicarbonate of lime is not perfectly removed by boiling; and that even after expulsion of all the so-called half-combined carbonic acid 3·5 of carbonate of lime remains dissolved in 100,000 of water; which consequently make up 2 German degrees of the permanent hardness of every water originally containing bicarbonate of lime. Then on the assumption that the above-mentioned grouping of the several constituents is correct, the permanent hardness of a water may be readily calculated if its percentage of alkalies, ammonia, sulphuric acid, hydrochloric acid, and nitric acid is known. Now the more impure the water, the less do the found and the calculated degrees of hardness agree. It appears that in such cases the excess of water must be combined with organic bases. It is very probable that between ammonia and the original nitrogenous organic bodies there exists a series of transition products possessing more or less decidedly basic properties. If nitric acid exists partially at least combined with organic bases the remarkable phenomenon is explained that spring waters, rich in nitric acid, contain—almost without exception—large amounts of organic matter. But whilst it is highly probable that the nitric acid of polluted wells is not, generally speaking, present as a lime or magnesium salt, nitrates and chlorides of these metals may have found their way into such, or, indeed, into any natural water. A great discrepancy between the amount of sulphuric acid as found, and as calculated from the permanent hardness of a water—in other words, a considerable amount of sulphate of potassa—may be considered as one of the indications of pollution.

Certain Substances of the Camphor Group, and on the Constitution of Camphor.—Aug. Kekulé.—A hypothetical dissertation on the true formulæ of camphor, of borneol, campholic acid, campheric acid, carvol, and carvacrol.

Preparation of Oxycymol from Camphor.—A. Fleischer and Aug. Kekulé.—The authors obtain oxycymol from camphor by cohobation with iodine.

Derivatives of Cymol.—Fr. Landolph.—The author has studied especially the nitro derivatives of camphorcymol, and obtained *a*-mononitro-cymol, $C_{10}H_{13}(NO_2)$.

Identity of the Cymols from Camphor, Ptychotis Oil, and Thymol, and on a Second Thiocymol.—F. Fittier.—The author considers the identity of these cymols demonstrated by his experiments. The new thiocymol has the composition $C_{10}H_{14}S$.

Action of Perchloride of Phosphorus upon Phenol-Parasulphonic Acid.—Aug. Kekulé.—The products of the reaction, which pass over between 60° and 120°, consist only of thionylchloride and oxychloride of phosphorus. At 265° to 267° a peculiar oil is separated out, whilst the intermediate products, when decomposed with water, yield a large quantity of bichlorbenzol.

Isomeric *a* and *β* Derivatives of Naphthalin.—C. Liebermann and Aug. Dittler.—Nitro-naphthylamin, $C_{10}H_6NH_2NO_2$, fuses at 191°, is sparingly soluble in water, readily in alcohol, and dyes wool an intense picric yellow. It does not form salts. It is isomeric with Beilstein's nitro-naphthylamin, which melts at 118° to 119°.

Decomposition of Rosanilin by Water.—C. Liebermann.—The author had formerly shown that when rosanilin is heated to temperatures above 240° along with water the atoms of nitrogen are successively eliminated as ammonia and replaced with equivalent amounts of water. He has since succeeded in obtaining the final product free from nitrogen. It has nothing in common with rosolic or hydrorosolic acid. It crystallises in colourless lancet-shaped leaflets. The compound fuses at 200°, and dissolves in dilute alkalies without colour. In water with soda-amalgam it dissolves with a transient red colour, like that which the anthrachinons and other chinons display under similar reducing reactions.

Dibenzyl-Disulpho Acid.—R. Kade.—The composition of this acid is $C_{14}H_{14}(SO_3)_2+5H_2O$. The author has examined the lead and barium salts.

On Dipropargyl.—Louis Henry.—A lengthy paper on the compound C_6H_6, with its reactions and combinations.

Gazzetta Chimica Italiana, Anno III., Fascicolo V. e VI., July 30, 1873,

Researches on Santonin.—S. Cannizzaro and F. Sestini.—The authors have obtained a substance composed of $C_{15}H_{20}O_4$, to which they give the name santonic acid. It is colourless, sparingly soluble in cold, but more freely in hot water, from which it is deposited on cooling in fine prismatic crystals. It is readily soluble in ether, and still more so in alcohol, also in chloroform, and in glacial acetic acid. It melts to a colourless liquid at 161° to 163°. On treatment with alcohol and caustic potassa it does not produce that fine red-violet colouration which characterises santonine. Its acid reaction is very decided, and it decomposes warm solutions of carbonates with brisk effervescence. The authors have further studied the santonates of sodium and barium, and the behaviour of the new acid with bromine and nascent hydrogen.

New Researches on Benzylated Phenol.—E. Paterno and M. Filetti.—In a former memoir (*Gazz. Chim.*, tome iii., p. 121) the authors described the preparation of anthracen from the action of chloride of benzyl upon phenol in presence of zinc, and announced the view that this hydrocarbon owed its origin to a transformation of benzylated phenol. Continuing the study of this substance they found that it can, in fact, furnish anthracen by a very simple reaction when distilled with anhydrous phosphoric acid.

Monochloride of Acetyl.—E. Paterno and G. Mazzara. Monochloride of acetyl when pure is a liquid perfectly transparent, and of a most pleasing odour, and sweetish, burning taste. Its boiling-point is 156·8°, and its sp. gr. is at 0° 1·0418, at 26·3° 1·0146, and at 99·9° 0·9315.

Chemical Analysis of Various Wines from the District of Verona.—Prof. Giovanni dal Sie.—A laborious contribution to agricultural chemistry, showing in a tabular form the age of 100 samples of wine, the names of the grower, their physical characters, their locality, the quality of the soil, the kind of grape, the percentage of alcohol, both by weight and volume, the proportion of residue on evaporating at 120°, the ash, the water, and the recorded character of fermentation.

Dry Distillation of the Formiate of Lime.—A. Lieben and E. Paterno.—Among the products obtained the authors especially notice methylic alcohol.

The Combustible Fossils of the Province of Siena Applied to Industrial Uses.—G. Campani and C. Giannetti.—("Memoire della R. Accademia der Fisiocritici di Siena, 1873.) An analysis of three samples of lignite.

Moniteur Scientifique, du Dr. Quesneville, August, 1873.

Researches of the Polymers of Morphia and their Derivatives.—Ludwig Mayer and C. R. A. Wright.—A translation from English sources.

New Procedures for the Manufacture of Coal-Gas.—T. Wills.—A translation from the *Journal of the Society of Arts*.

Theory of Tanning.—M. A. Reimer.—A continuation of the elaborate paper which we have already noticed.

The Regeneration and Restoration of Oil Paintings by Pettenkofer's Method. (A report presented to the Industrial Society of Mulhouse.)—M. Fr. Goppelsroeder.—Radlkofer has proved that the deterioration of paintings is not due, as was suspected, to organic formations. It is evident that colours, even the most stable, cannot preserve their original shade and brightness, except on condition that the drying oil, which has interpenetrated them, and in which they are in a manner suspended, retains its optical properties. The most important part of the oils employed by artists is linoleine. This body not being procurable in a state of purity, painters are obliged to use linseed oil in which it is present in the proportion of 80 per cent; or propyl oil, of which it constitutes 75 per cent. Linoleine, originally liquid, solidifies by oxidation without decrease in bulk, but increasing in weight to the extent of 10 per cent. It is then a hard transparent mass, which encloses the colours and the other portions of the oil. It is because linoleine acquires on exposure to the air a consistence invariable at the different temperatures of the atmosphere that the portions of colour when the painting is dry can no longer be displaced, whether by a gentle pressure, or by the fatty and volatile oils and varnishes. As there are, everywhere in the world, atomic and molecular movement, changes physical and chemical take place in paintings. These changes occur more frequently in the oil than in the colour. The colours containing the least oil change most. Pettenkofer's method of restoring pictures is very simple. He makes first a trial on a small scale by means of a round pasteboard box, plastered within with strong glue, and the bottom of which is lined with flannel moistened with alcohol at 80 per cent. The box is inverted and placed upon the picture. The part thus treated serves as a guide for the operations on a larger scale. In the latter a box is employed, the bottom of which is lined with flannel, whilst the picture is fixed to the lid. Pettenkofer employs also balsam of copaiba, which is often applied with success to the back of the picture.

On Alimentary Substances in General, and on the Extract of Meat in Particular, Regarded as the Food of Man.—Dr. Max von Pettenkofer.—We extract from this valuable paper the following significant passage:—"It is only a short time ago that it was customary in physiology to speak of a superfluous or luxurious consumption. According to certain physiologists as long as the body is able to perform its functions, even though suffering from hunger, to take more food was luxury. But Bischoff and Voit fully demonstrated by their experiments on nutrition that the result of a nourishment so restricted is a state of want—a continual famine incompatible, in the long run, with the normal conditions of life. The body has need of a certain well-being—of a small excess of nourishment in order to preserve its strength and vigour. What just prevents death from hunger is not sufficient. It is as if we were to restrain the organism from producing any more heat than suffices to prevent death from cold, under pretext that all beyond this limit was superfluity and luxury."

The Farina of Meat and the Salts of Meat.—Dr. Dunkelsberg.—The author points out the importance of mineral salts in the nutrition of animals.

Revue Scientifique de la France et de l'Etranger, August 16, 1873.

This number contains no chemical matter.

Revue des Deux Mondes, July 15, 1873.

The New Explosives.—M. F. Papillon.—The author estimates the pressure exerted upon a cannon-ball by common gunpowder at 5000 atmospheres. The temperature produced by its ignition he considers to be 2500°. Berthelot's table of the relative heats, volumes of gas, and explosive forces obtained by means of gunpowder, chlorate powder, gun-cotton, picric acid, and nitroglycerine is then quoted. (We suspect that Berthelot must have used in his experiments gun-cotton weakened by a considerable amount of dinitro-cellulose.) He gives the highest rank to liquefied protoxide of nitrogen, mixed with ether or other liquid carbides.

Reimann's Färber Zeitung, No. 27, 1873.

This number contains receipts for a scarlet on cloth, in which the following mordant or "spirit" is employed:—12 lbs. bichloride of tin, and 12 lbs. tin crystals dissolved in water enough to form a solution at 36° B. Further, for a yellowish green on cloth, a "May green," a golden yellow; for scarlet, rose, and salmon on woollen yarn, to be produced in succession from the same bath; for a roe shade on wool, for a lemon yellow; a fine black for silk waste; a fine logwood blue (a substitute for a vat blue) upon cotton-wool, and for finishing velvets. The following process for dyeing linen yarn with aniline colours has been patented by Hainisch, of Vienna. The yarn is worked alternately in the two following solutions:—(1) 1 part tannin in 500 parts of water. (2) 1 part glycerin in 32 parts of water, to which egg albumen is added. The yarn remains in each about ten minutes. For very delicate shades No. 1 is omitted. (The only novelty in this patent is its astonishing audacity.)

No. 28, 1873.

This number contains a notice of the Vienna Exhibition from a colourist's point of view, followed by receipts for an alkali blue on woollen yarn or piece goods; for a new alkali on flannel; for light and dark drab-grey on woollen yarn; heavy black on wool; blue-black, bright blue, sandal-brown, and red-brown on the same; instructions for finishing off velvet after dyeing; grey on leather; coralline-red on cotton; and mat finish for lining-cottons. The editor criticises Lauth's assumption that the dimethylanilin used in the manufacture of violet-de-Paris (methyl violet) is perfectly free from toluidin compounds. MM. Lloyd and Green propose to prepare an oil for mordanting yarn and cloth to be dyed Turkey red, by adding, to 1 part of oil, 14 parts of a solution of bleaching soda (hypochlorite of soda at 3½° Twaddell). The goods prepared with this emulsion are fit for dyeing sooner than if treated in the ordinary manner.

Revue Hebdomadaire de Chimie Scientifique et Industrielle par Ch. Mène, May 15, 1873.

This number contains an account of apparatus for heating wines (Pasteur's process), a description of some artistic earthenware, and of a new continuous press for the sugar manufacture. The process of Zettnow for purifying hydrochloric acid is as follows:—The crude acid of sp. gr. 1·6 (that sold in this country rarely exceeds 1·17), and free from iron, is mixed with a little chlorine-water and chloride of lime, to oxidise sulphurous acid if present. It is then stirred up with commercial protochloride of tin (tin crystals), in the proportion of 50 grms. to 10 to 12 kilos. of raw acid, or nearly 2 ounces to 2 gallons. The separation of arsenic and the clarification of the acid are complete after twenty-four hours rest at the temperature of 30° to 35°, and after one to four days at ordinary temperatures. It is then distilled, with the addition of a little common salt and a little sand to regulate the ebullition. The method of Engel, which depends on the use of the hypophosphate of potash, has been already noticed.

Artificial Marble.—G. A. Frear.—This invention consists in the employment of a solution of sulphate and chloride of zinc, sugar of lead, alum, and common salt, mixed in suitable proportions, and dissolved in water to agglomerate the particles of powdered silica, alumina, marble cement, hydraulic cement, sulphate of lime, baryta, and other earthy substances except carbonate of lime.

THE CHEMICAL NEWS.

VOL. XXVIII. No. 718.

ON THE

SPECIFIC GRAVITY OF RUBIES AND SAPPHIRES.

By GREVILLE WILLIAMS, F.R.S.

IN my paper "Researches on Emeralds and Beryls,"* I stated that the artificial rubies made by me by Gaudin's process, had a lower specific gravity than that of the true ruby. I there assumed the density of the ruby to be 3·53, on the authority of Brisson,† and that of the sapphire as 3·56, according to Muschenbroek.‡ Having occasion, in extending my experiments on the subject, to take the specific gravity of several rubies and sapphires, I found their density to be very much higher than the numbers given in Gmelin's "Chemistry." On referring to other works,‖ I found the numbers given in them to be generally between 3·9 and 4·0; Professor Church also found a blue sapphire to have a density of 3·979, and a yellow one 4·030. My own determinations, made upon very fine stones, gave me for rubies 3·95, and for sapphires 3·98. Assuming 3·95 as the average specific gravity of the ruby, it will be seen that Gaudin's rubies as first made by me were 0·5 lower in density than the native ruby, instead of 0·08 as given in my former communication. I have, however, recently succeeded in preparing some fresh specimens of artificial rubies by the same process, but with a higher density, namely 3·7; this number is only 0·25 lower than the native ruby, and I think it probable that the true density of the ruby might be attained if the frothing, which takes place to a greater or less degree under the intense heat of the oxyhydrogen blowpipe, could be completely avoided.

THE CHEMICAL CONSTITUTION OF SUCCINIC, MALIC, AND TARTARIC ACIDS, CRITICALLY EXAMINED AND INTERPRETED

FROM THE STAND-POINT OF THE

"TYPO-NUCLEUS" THEORY.

By OTTO RICHTER, Ph.D.

(Concluded from p. 91).

PART III.

On the Principal Molecular Changes that Accompany the Artificial Production of the Water-Salts of Succinic, Malic, and Tartaric Acids in our Laboratories.

UNDER this head a number of interesting cases have fallen under my notice, out of which I shall select the following four:—The first case refers to the artificial production of the ortho- and iso-succinate, which, according to Byk and Wichelhaus, may be got by boiling the corresponding varieties of cyan-propionate with potash ley. The second case refers to the artificial production of the ortho-succinate, which, according to Simpson, may be got by boiling the di-cyanide of ethylen with potash ley. The third case refers to the artificial production of the ortho-tartrate (the inactive form), which, according to Debus, is generated on treating a mixture of glyoxal and hydrocyanic acid with solution of potash. The fourth case refers to the artificial production of the ortho-tartrate (the racemic variety) which, according to Heintz, is found among the products of oxidation of the ordinary glycerate of water.

The proper discussion of the first case renders it incumbent on me to examine more minutely into the chemical origin and constitution of the nitrogenous substances that form the basis of these experiments.

In the first place, as regards the cyan-propionate. This compound, which gives rise to the ortho-succinate, may be prepared by the following method:—When ethylen, $2H_4C_4$, is exposed to the action of phosgen gas, $2C_2Cl_2O_2$, the product of their direct union is the chlor-propionyl chloride, and the molecular changes attending its formation are believed to be as follows:—In the first stage, the phosgen splits up into carbonic oxide and free chlorine, which, by an action strictly analogous to that of oxygen (*vide* Part I.), effects the conversion of the ethylen into the biatomic dichloride of ethylen—

$$2H_2C_2 ; H_2Cl_2 \sim 2C_2 ; H_2Cl_2.$$

In the second stage, the methylen adjunct of the latter parts with its 2 mols. of hydrogen, which are oxidised into 2 mols. of water at the expense of the carbonic oxide, but these 2 water mols., instead of being eliminated, are instantly brought to bear upon the residual carbon nucleus, so as to give birth to a mol. of formite of water. In the third stage, the formous acid constituent of this latter enters into chemical union with the dehydrogenated di-chloride of ethylen, with production of the chloride in question, the chemical constitution of which is, therefore, expressed by the formula—

$$\frac{}{2C_2 ; H_2Cl_2 \sim 2C_2 ; H_2Cl_2 : 2H ; 2C_2O.} \quad H_2O_2.$$

In contact with water, this substance becomes speedily decomposed into hydrochloric acid and the chlor-propionate—

$$\frac{H_2O_2. \quad H_2O_2.}{2C_2 ; H_2Cl_2 \sim 2C_2 ; H_2O_2 : 2H ; 2C_2O,}$$

which, by treatment with cyanide of potassium, &c., becomes finally converted into the cyan-propionate—

$$\frac{2C_2N. \quad H_2O_2. \quad H_2O_2.}{2C_2 ; H_2N_2 \sim 2C_2 ; H_2O_2 : 2H ; 2C_2O.}$$

In the second place, as regards the iso-cyan-propionate. This compound, which gives rise to the iso-succinate, may be prepared by the following method:—When 1 mol. of iso-lactate (ordinary lactate) of lime—

$$\frac{H_2O_2. \quad Ca_2O_2.}{\alpha) \; 2(H_2C_2 : C_2) ; H_2O_2 : 2H ; 2C_2O_3,}$$
$$\beta) \; 2H_2C_4 ;$$

is acted upon by 2 mols. of perchloride of phosphorus, it becomes transformed into the iso-chlor-propionyl chloride—

$$\alpha) \; 2(H_2C_2 : C_2) ; H_2Cl_2 : 2H ; 2C_2ClO_2.$$
$$\beta) \; 2H_2C_4 ;$$

In contact with water, this substance readily decomposes into hydrochloric acid and the iso-chlor-propionate—

$$\frac{}{\alpha) \; 2(H_2C_2 : C_2) ; H_2Cl_2 : 2H ; 2C_2O_3,} \quad H_2O_2.$$
$$\beta) \; 2H_2C_4 ;$$

which, by treatment with cyanide of potassium, &c., becomes finally converted into the iso-cyan-propionate—

$$\frac{2C_2N. \quad H_2O_2.}{\alpha) \; 2(H_2C_2 : C_2) ; H_2N_2 : 2H ; 2C_2O_3.}$$
$$\beta) \; 2H_2C_4 ;$$

Let us further contemplate the molecular changes, which attend the conversion of these two isomeric varieties of cyan-propionate into the corresponding succinates. The copious evolution of ammonia in both cases clearly shows, that the alkali has effected the decomposition of these bodies into the lactate (so-called para-lactate, and identical with the glyceric aldehyd of Socoloff) and into the iso-lactate, while the liberated hydrocyanic acid has been made to resolve itself into ammonia and formate of water.

* *Proc. Roy. Soc.*, 1873, No. 145, p. 409.

† Gmelin's "Chemistry," Cavendish Society's translation, vol. iii., p. 305.

‡ *Loc. cit.*

‖ "Brooke and Miller," "Watts's Chem. Dict.," "Rammelsberg," &c.

Before proceeding farther, and with the view of still more fully confirming my conception of the molecular structure of lactic and iso-lactic acids, I have deemed it advisable to interlace an analysis of the principal molecular changes which accompany the artificial production of these two isomerides. I allude to the beautiful synthetical processes, devised by Wislicenus and Lippmann, whereby, according to the former chemist, ethyliden cyan-hydrate—

$$\overline{2C_2\,;\,H_2O_2 : 2H_2C_2\,;\,H_2N_2}\quad \begin{matrix} H_2O_2. & 2C_2N. \end{matrix}$$

is converted by ebullition with potash into a salt of iso-lactic acid, while, according to the latter chemist, ethylen cyan-hydrate—

$$\overline{2H_2C_2\,;\,H_2N_2 \sim 2C_2\,;\,H_2O_2}\quad \begin{matrix} 2C_2N. & H_2O_2. \end{matrix}$$

is transformed under similar circumstances into lactic acid. Now, on the principles which guide me in the interpretation of chemical phenomena, the ethyliden cyan-hydrate ought to give rise first of all to the intermediate product—

$$\overline{2C_2\,;\,H_2O_2 : 2H_2C_2\,;\,H_2O_2 : 2H\,;\,2C_2O_3},\quad \begin{matrix} H_2O_2. & H_2O_2. & H_2O_2. \end{matrix}$$

which, through the loss of 2 mols. of water, caused by the splitting up of the colligated formylic alcohol, and the coalescence of the liberated formen with the methylen adjunct, changes afterwards into the iso-lactate, whereas the ethylen cyan-hydrate ought to furnish the lactate directly—that is, without formation of an intermediate product—whose formula would be—

$$\overline{2H_2C_2\,;\,H_2O_2 \sim 2C_2\,;\,H_2O_2 : 2H\,;\,2C_2O_3}.\quad \begin{matrix} H_2O_2. & H_2O_2. & H_2O_2. \end{matrix}$$

I have, indeed, good grounds for affirming, that the kind of molecular arrangement implied by this latter formula, whereby an olefine-begotten polyatomic alcohol is made to discharge the functions of a halogen adjunct, is a chemical incongruity, but that the obstacle to chemical union is removed by the conversion of that alcohol into the corresponding de-alcohol.

Reverting, again, to the intermediate product preceding the formation of the iso-lactate, a remarkable and highly instructive contrast is brought to light by the following train of reasoning:—Observe, first, that the colligated alcohol of that product is the mono-acid, but still biatomic ethyliden glycol or glycolic alcohol, while the colligated alcohol of the other and, as I believe, impracticable transition product, is the biacid and biatomic ethylen glycol. Observe, in the second place, that if in the above reaction the methylen adjunct of the glycolic alcohol had experienced, at the expense of the associated formic acid principal, a water-producing process of dehydrogenation, similar to what the same adjunct is supposed to have undergone in the ethylen glycol, the resulting compound ought to be constituted according to the formula—

$$\overline{2C_2\,;\,H_2O_2 : 2C_2\,;\,H_2O_2 : 2H\,;\,2C_2O},\quad \begin{matrix} H_2O_2. & H_2O_2. & H_2O_2. \end{matrix}$$

which shows it to be a new isomeride of lactate of water, of the real occurrence of which I myself have not the slightest doubt. But, considering that the actual product obtained is the iso-lactate of water, whose formula rests upon the concordant testimony of a great variety of analyses, the conclusion seems to me inevitable, that the typical metamorphosis, which the ethylen-glycol has experienced in the act of passing into the isomeric glycolic alcohol, is sufficient to protect the methylen adjunct against the rigorous enforcement of a law, which demands the unconditional surrender of two hydrogen molecules on the part of the olefine adjunct of a given mono- or poly-atomic alcohol, before it can be admitted into chemical fellowship with a given acid principal.

This subject may be fitly concluded by appending a list of all the theoretically-possible isomerides of lactate of water, several of which have now been obtained in a state of isolation.

Table of the Theoretically-possible Isomerides of Lactate of Water.

1) Lactate, $\overline{2C_2\,;\,H_2O_2 \sim 2C_2\,;\,H_2O_2 : 2H\,;\,2C_2O}.$ $\begin{matrix} H_2O_2. & H_2O_2. & H_2O_2. \end{matrix}$

2) Iso-lactate, $\alpha)$ $\overline{2(H_2C_2 : C_2)\,;\,H_2O_2 : 2H\,;\,2C_2O_3}.$ $\begin{matrix} H_2O_2. & H_2O_2. \end{matrix}$
$\beta)$ $2H_2C_4\,;$

3) Para-lactate, $\alpha)$ $\overline{2(H_4C_2 : HC_2)\,;\,2C_2O_5}.$ $H_2O_2.$
(oxypropionate) $\beta)$ $2H_5C_4\,;$

4) Kata-lactate, $\overline{2C_2\,;\,H_2O_2 : 2C_2\,;\,H_2O_2 : 2H\,;\,2C_2O}.$ $\begin{matrix} H_2O_2. & H_2O_2. & H_2O_2. \end{matrix}$

5) Methyl-glycolate, $2C_2\,;\,H_2O_2 : 2H\,;\,2C_2O_3.$ $\begin{matrix} 2H_2C_2. & H_2O_2. \end{matrix}$

6) Glycolate of methyl, $\overline{2C_2\,;\,H_2O_2 : 2H\,;\,2C_2O_3}.$ $\begin{matrix} H_2O_2. & H_2O_2. \end{matrix}$

7) Aceglycolate, $2C_2\,;\,H_2O_2 : 2H_3C_2\,;\,2C_2O_3.$

Let us now, after this somewhat lengthy, but, I trust, not unwelcome digression, resume our inquiry into the nature of the molecular changes which accompany the artificial production of the succinate and iso-succinate at the point where it was said that the action of the alkali upon the two varieties of cyan-propionate had given rise to two varieties of lactate, besides ammonia and formate of water. In the second stage, the formic acid constituent of this water-salt unites as ally with the formous acid principal of the lactate on the one hand, and with the formic acid principal of the iso-lactate on the other hand. The resulting compounds are, therefore, in the former case a bibasic meta water-salt—

$$\overline{2C_2\,;\,H_2O_2 \sim 2C_2\,;\,H_2O_2 : 2H\,;\,2C_2O \sim 2H\,;\,2C_2O_3},\quad \begin{matrix} H_2O_2. & H_2O_2. & H_2O_2. & H_2O_2. \end{matrix}$$

and in the latter case a bibasic meta water-salt—

$$\alpha)\ \overline{2(H_2C_2 : C_2)\,;\,H_2O_2 : 2H\,;\,2C_2O_3 \sim 2H\,;\,2C_2O_3}.\quad \begin{matrix} H_2O_2. & H_2O_2. & H_2O_2. \end{matrix}$$
$\beta)$ $2H_2C_4\,;$

The third stage is characterised by the splitting up of these two isomeric water-salts into 2 molecules of water and the corresponding meta-anhydrides, which, by the method of ortho-genesis, are finally transformed, the one into the ortho-succinate—

$$\overline{2C_2\,;\,H_2O_2 \sim 2C_2\,;\,H_2O_2 : 2C_2O \sim 2C_2O},\quad \begin{matrix} H_2O_2. & H_2O_2. & H_2O_2. & H_2O_2. \end{matrix}$$

and the other into the iso-succinate—

$$\alpha)\ \overline{2(H_2C_2 : C_2)\,;\,H_2O_2 : 2C_2O \sim 2C_2O_3}.\quad \begin{matrix} H_2O_2. & H_2O_2. & H_2O_2. \end{matrix}$$
$\beta)$ $2H_2C_4\,;$

It will be seen on comparison, that these two formulæ agree completely with those I have already, but on different grounds, been brought to regard as the true exponents of the chemical constitution of the two isomerides in question.

Let us now examine into the second case, which refers to the artificial production of the ortho-succinate from the dicyanide of ethylen, the chemical constitution of which is expressed by the formula—

$$\overline{2H_2C_2\,;\,H_2N_2 \sim 2C_2\,;\,H_2N_2}.\quad \begin{matrix} 2C_2N. & 2C_2N. \end{matrix}$$

It is clear that the formation of this latter compound from the dichloride of ethylen must be preceded by an intermediate product—

$$\overline{2H_2C_2\,;\,H_2Cl_2 \sim 2C_2\,;\,H_2N_2},\quad 2C_2N.$$

which, by treatment with potash ley, ought to furnish the above-mentioned chlor-propionate; while, under the same circumstances, the dicyanide ought to give rise, in the

first instance, to the above-mentioned cyan-propionate, for the rationale of whose conversion into the ortho-succinate it is, therefore, sufficient to refer the reader to the explanations given under the head of that compound.

The third case has for its object the artificial production of the ortho-tartrate of water* (the optically-inactive variety), the proper comprehension of which necessitates, however, a previous acquaintance with the molecular structure of the so-called glyoxal. According to my researches, this aldehyd-like substance is the lowest acid heterologue of an organic family group, whose unknown parent alcohol is represented by the formula—

$$\overline{2C_2O_2 : 2H_2C_2 ; H_2O_2}.^{H_2O_2}$$

The following scheme exhibits two closely related organic family groups, headed by their respective parent alcohols, and so arranged as to illustrate the complete parallelism of the two series :—

First Family Group of Heterologues.

Glycolic alcohol, $\overline{2C_2 ; H_2O_2 : 2H_2C_2 ; H_2O_2}.^{H_2O_2}$

De-glycolic alcohol, $2C_2 ; H_2O_2 : 2C_2 ; H_2O_2.$

Glycolite, $\overline{2C_2 ; H_2O_2 : 2H ; 2C_2O}.^{H_2O_2}$

Glycolate, $2C_2 ; H_2O_2 : 2H ; 2C_2O_3.$

Glycoloate, $\overline{2C_2 ; H_2O_2 : 2H ; 2C_2O_5}.^{H_2O_2}$
(glyoxylate)

Second Family Group of Heterologues.

Glyoxalic alcohol, $\overline{2C_2O_2 : 2H_2C_2 ; H_2O_2}.^{H_2O_2}$

De-glyoxalic alcohol, $2C_2O_2 : 2C_2 ; H_2O_2.$

Glyoxalite, $2C_2O_2 : 2H ; 2C_2O.$
(glyoxal)

Glyoxalate, $2C_2O_2 : 2H ; 2C_2O_3.$

Glyoxaloate, $2C_2O_2 : 2H ; 2C_2O_5.$

N.B.—It deserves to be specially noticed, that the glyoxaloate, as well as the para-oxalate previously alluded to, are bimeric modifications of the ordinary oxalate.

With the aid of this scheme, the whole process may now be explained in the following terms :—In the first stage, the glyoxalite becomes converted into the glycolite, the 2 molecules of hydrogen required for that purpose being, as usual, derived from 2 water molecules, whose oxygen serves to transform into a molecule of formoate one of the 2 molecules of formate that were generated by the action of the alkali on the two accessory hydrocyanic acid molecules, while the other molecule of formate of water enters into chemical union with the freshly-formed glycolite. The product of this union, viz., the bibasic meta-glycerate—

$$\overline{2C_2 ; H_2O_2 : 2H ; 2C_2O - 2H ; 2C_2O_3}.^{H_2O_2}\ ^{H_2O_2}$$

merges afterwards into the isomeric modification of the monobasic glycerate, but in the act of doing so an opportunity is afforded to the acid constituent of the aforesaid formoate of linking itself to the formic acid principal of the glycerate. It will be seen that the resulting bibasic meta water-salt—

$$2C_2 ; H_2O_2 - 2C_2 ; H_2O_2 : 2H ; 2C_2O_3 - 2H ; 2C_2O_5,^{H_2O_2}\ ^{H_2O_2}\ ^{H_2O_2}\ ^{H_2O_2}$$

is absolutely identical with the transition product encountered in my analysis of the slow and gradual oxidation of the butylen-erythrol; it will, therefore, agree with the latter in resolving itself into 2 molecules of water and the ortho-tartrate in question. The fourth, and last, case has for its theme the artificial production of the ortho-tartrate from the ordinary glycerate. According to Heintz, the oxidation of this compound gives rise, amongst others, to the water-salts of formic, glycolic, glycoloic, and tartaric acids, while carbonic acid is given off. The simultaneous appearance of these substances is easily accounted for on the hypothesis that the monobasic glycerate, after merging into the isomeric form of the bibasic meta-glycerate, splits up into 2 molecules of water and the tartronate, which soon resolves itself into carbonic acid and the glycolate, whence the glycoloate is finally obtained by the union of the latter with 2 molecules of oxygen. In the next stage, the glycoloate breaks up into the formylic alcohol, which is speedily oxidised into the formate and into the formoate, the acid constituent of which unites as ally with the formic acid constituent of the meta-glycerate, while it is in the act of re-assuming the monobasic form of grouping. Hence the resulting combination will be expressed by the formula—

$$\overline{2C_2 ; H_2O_2 - 2C_2 ; H_2O_2 : 2H ; 2C_2O_3 - 2H ; 2C_2O_5},^{H_2O_2}\ ^{H_2O_2}\ ^{H_2O_2}\ ^{H_2O_2}$$

which is again, as in the preceding case, absolutely identical with that remarkable transition product which was shown to be the immediate precursor and originator of the ortho-tartrate under consideration.

It cannot be denied, that the synthetical formation of organic compounds belonging to that distinguished family circle, which owns the tartrate for one of its most highly oxidised acid heterologues, is a fact of the deepest import and significance; and certainly, when I consider the great compactness, cogency, and coherence which competent judges will do me the justice of enumerating among the commendable qualities of my peculiar method of reasoning, I would fain persuade myself that my researches have revealed the true *modus operandi*, according to which the carbon-nuclei of one, two, or more molecules of hydrocyanic acid, originally introduced into a given molecule as non-essential elements, or co-existing in the same solution, and in close proximity to that molecule, may become permanently incorporated therein as essential elements. The reader is no doubt aware that several curious and interesting cases of this kind have recently been put on record, among which I may mention the artificial production of the ortho-pyrotartrate from the dicyanide of propylen, the iso-pyrotartrate from the iso-cyan-butyrate, and the carballylate from the tricyanide of allyl. A full discussion of these and other analogous cases is reserved for my paper "On the Chemical Constitution of Citric Acid and its numerous Derivatives," where I hope still more emphatically and conclusively to demonstrate the general soundness and validity of this entirely novel, but as yet practically untested, section of my "typo-nucleus" theory.

It is now time to take temporary leave of my subject, which, so far from being exhausted, may yet be contemplated under a variety of aspects and conditions. Among these, I may single out in particular the action of bromine on our three acid heterologues, the rationale of which I purpose communicating in one of my next papers.

Finally, and in conclusion, I have deemed it advisable, for the special consideration of those who may desire to prosecute their chemical studies in the spirit of the "typo-nucleus" theory, of appending the following two schemes, for the proper interpretation of which I must refer the reader to the subjoined explanatory note.

* The reader will bear in mind, that in my system all variations in the optical properties of a given molecule, so far from being due to differences of molecular grouping, are held to depend entirely and exclusively on the symmetrical or unsymmetrical distribution of the atomic vibratory movements around the three principal crystallographic axes of that molecule.

General Guide.

Water-salts.		Affixes. -ite.	-éite.	-ate.	-éate.	-oate.
Monobasic	—	1	—	3	—	5
Bibasic	Meta series	1–3	3–3	3–5	5–5	—
	Ortho series	1–1	1–3	3–3	3–5	—
Tribasic	Meta series	1–1–3	1–3–3	1–3–5	3–3–5	3–5–5
	Ortho series	1–1–1	1–1–3	1–3–3	3–3–3	3–3–5

First Scheme.

Triatomic System.

Parent alcohol :

Propylen-glycerol—

$$\frac{H_2O_2. \quad H_2O_2. \quad H_2O_2.}{2H_2C_2 ; H_2O_2 - 2C_2 ; H_2O_2 - 2C_2 ; H_2O_2.}$$

Monobasic water-salts :

Glycerite—

$$\frac{H_2O_2. \quad H_2O_2. \quad H_2O_2.}{2C_2 ; H_2O_2 - 2C_2 ; H_2O_2 : 2H ; 2C_2O.}$$

Bibasic water-salts :

Meta-glycerite—

$$\frac{H_2O_2. \quad H_2O_2. \quad H_2O_2.}{2C_2 ; H_2O_2 : 2H ; 2C_2O - 2H ; 2C_2O_3.}$$

Ortho-glycerite—

$$\frac{H_2O_2. \quad H_2O_2. \quad H_2O_2.}{2C_2 ; H_2O_2 : 2C_2O - 2C_2O.}$$

Second Scheme.

Tetratomic System.

Parent alcohol :

Butylen-erythrol—

$$\frac{H_2O_2. \quad H_2O_2. \quad H_2O_2. \quad H_2O_2.}{2H_2C_2 ; H_2O_2 - 2C_2 ; H_2O_2 - 2C_2 ; H_2O_2 - 2C_2 ; H_2O_2.}$$

Monobasic water-salts :

Erythrite—

$$\frac{H_2O_2. \quad H_2O_2. \quad H_2O_2. \quad H_2O_2.}{2C_2 ; H_2O_2 - 2C_2 ; H_2O_2 - 2C_2 ; H_2O_2 - 2H ; 2C_2O.}$$

Bibasic water-salts :

a Meta-erythrite—

$$\frac{H_2O_2. \quad H_2O_2. \quad H_2O_2. \quad H_2O_2.}{2C_2 ; H_2O_2 - 2C_2 ; H_2O_2 : 2H ; 2C_2O - 2H ; 2C_2O_3.}$$

b Ortho-erythrite—

$$\frac{H_2O_2. \quad H_2O_2. \quad H_2O_2. \quad H_2O_2.}{2C_2 ; H_2O_2 - 2C_2 ; H_2O_2 : 2C_2O - 2C_2O.}$$

b Meta-erythrite—

$$\frac{H_2O_2. \quad H_2O_2. \quad H_2O_2.}{\begin{matrix} \alpha) \ 2(C_2 : C_2) ; H_2O_2 : 2H ; 2C_2O - 2H ; 2C_2O_3. \\ \beta) \ 2C_4 ; \end{matrix}}$$

c Ortho-erythrite—

$$\frac{H_2O_2. \quad H_2O_2. \quad H_2O_2.}{\begin{matrix} \alpha) \ 2(C_2 : C_2) ; H_2O_2 : 2C_2O - 2C_2O. \\ \beta) \ 2C_4 ; \end{matrix}}$$

Note.—Let it be understood that the name given to the lowest heterologue of each component group of bibasic or tribasic water-salts is compounded of a prefix, a root, and an affix. The prefix consists of the words *meta* or *ortho*, implying that the molecule is moulded on the formyl type or on the oxalyl type; the root is contained in the name of the parent alcohol; and the affix consists of the syllable *ite*. In the "general guide" this syllable is followed by a given number of affixes, by the substitution of which for the first we are enabled to designate the higher or more oxidised members of each component group. Finally, sets of figures, linked together by twos or threes, and placed below each affix, serve to indicate the relative number of oxygen molecules contained in the acid principal and associated allies of the corresponding bibasic or tribasic water-salts.

ON THE ENERGIES OF THE IMPONDERABLES,

WITH ESPECIAL REFERENCE TO THE

MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 93.)

As an illustration of this principle of least action, look at that most extraordinary muscle of all in the animal economy—the heart. Although certain features of its action should come under notice at a later portion of the evening, yet it bears upon the present subject, in that it is a bundle of small muscular fibres. There are probably more than a million of them, complex in their arrangements and perplexingly curious in their relative and combined actions, and yet this, regarded as one muscle, weighs on an average, in man, only 9·39 ozs. Its screw-like construction is such that at each action it propels forward the whole of its contents, leaving no filled-in corners. It has power to propel these contents to the vessels in the extremities of the body. Were not this muscle "up to the mark," these extremities would die for want of nourishment; if, "beyond the mark," then some of the vessels along which the blood is driven might be burst in consequence of a liquid pressure greater than that they were calculated to sustain.

The balances required are perfect, and this little muscle of 9·39 ozs. sends life to all parts of the body—by day and by night—from birth to death. Now the work it is continually performing is as though it lifted its own weight through nearly 20,000 feet in an hour. The height of St. Paul's Cathedral, from the ground to the top of the cross, is 404 feet; therefore the heart could place itself on the top of St. Paul's Cathedral nearly fifty times in one hour. Let a man consider how often in an hour he could ascend, even on the assumption that he was never tired, and then he may obtain an idea how much more work his heart is doing than he can do. Put otherwise, the heart, regarded as we regard a locomotive, can raise itself through a vertical height of nearly 4 miles in one hour. The most powerful locomotives, built specially for the ascent of gradients, can only raise their own weight through about half-a-mile, or one-eighth of that which the heart can do. The directors of an Alpine railway (that from Trieste to Vienna) offered a prize for the locomotive which could lift its own weight through the greatest height in one hour. It was allotted to the locomotive (Bavaria), which lifted its own weight in one hour through 2700 feet, or about half-a-mile. The experiment was simply made by means of inclines or railway lines; the subject this evening does not warrant a larger reference to this matter.

By no contrivance can we make a machine which shall bear such proportions between size and work as the heart does. Here is a little machine, weighing say 10 ozs., put in action and worked by vitality, as a steam-engine is worked by heat; and this little engine, which we could easily put in our pockets, can lift itself 20,000 feet high in an hour. There must indeed have been a master-mind that designed and executed the manufacture of the animal machinery, and so perfectly carried out the "principle of least action."

By careful anatomical and mathematical investigations similar to those which are to be alluded to near the close of this lecture, the daily work of the heart can be shown to be 124 foot-tons. This is nearly one-third of the daily labouring force of the whole body.

This muscle of the heart is not only capable of exerting this wonderful power through the action of the vital force, but it seems not to need any rest, and yet it does not wear out, for the muscles in the heart of an old man are apparently as sound and healthy and fit for continuous

* The Cantor Lectures, delivered before the Society of Arts.

work as those in the heart of a youth. How through life they have been so maintained, how as other muscles in the frame lose somewhat of energetic power, yet these fail not, is one of the many perplexities to science. That muscular power is, as we may say, restored by rest and food, any one who cares to think upon what he experiences and witnesses will readily admit; indeed, further, the nature of the work and the character of the food must be suited each to the other. Now the muscles of the heart never rest. The variation in their energy is within very narrow limits, so narrow that we may say that any series of observations, however long continued and whenever taken—as a series—would always average the same result. Hence the inference that in the animal economy these muscles possess the power (peculiar probably to themselves) of at one and the same time parting with energy and restoring it. This ever-balanced and ever-exerted energy, this actual external utilisation of energy, coupled with a perfectly self-recuperative operation, is what the searcher for perpetual motion, like the asymptote to the hyperbola, is ever approaching, but never attaining.

If men can find out how these particular muscles are exempted from the laws of muscle, with which laws these Cantor Lectures are mainly concerned, they will have advanced further in solving the problem of perpetual motion, which some enthusiast in every generation pursues with commendable, but hitherto unsuccessful, zeal.

The energy of vitality, as utilised and controllable by ourselves, is chiefly through the agency of muscles. The physiologist regards these muscles, with their attached tendons and nerves, as to the functions and offices they discharge in the economy of the individual; we are to regard them as to the external use to which they may be applied, and the work to be obtained from them. How much we copy from Nature may be concluded when we refer to the earliest attempt at locomotion from machinery. It was by basing the form and structure upon the muscles of animals. To thus imitate muscular action has hitherto baffled the ingenuity of man. If anyone has not satisfied himself of the nature of this action, let him put the hand on the muscles of the arm when it is in repose; they are soft and yielding. Let him now make an exertion with the arm, such as raising a weight; the muscles become tense and hard. The weight raised is extraordinary compared with the weight of muscle employed, for it may be from 16,000 to 17,000 times its own weight.

The physiologist considers the striated and unstriated variety of muscle, the nucleated cells, the vitality in each cell, the electrical relations of various tissues. With none of these need we be concerned.

Engineers regard muscles as machines for doing work, and, as it is needful to know the structure of a machine before we can say how it can be made to work, so now the structure of muscle, as a machine, must be considered.

When a muscle is examined after vitality has ceased, it is found to consist of a great number of separate parts, or strings. If this piece of string were a muscle, there would be a bundle of strings or fibres together—just the same as if I had doubled the string several times,—and encasing them there is a covering or sheath, much the same as an india-rubber tube, which covering encloses a number of muscular fibres or strings. That covering has none of the contractile elements of the muscle in it; it is merely an elastic covering enclosing that which has the contractile powers. Then, side by side with this bundle of fibres or strings, in its case, is another one, also covered in the same way, and another, and another. These are kept in their place by the tubing or covering spoken of, and a combination of these is called a muscle, which consists, then, of these fibres, which, again, are separated into fibrillæ. With such a peculiar arrangement of contractile strings, it is clearly a problem for the mathematician and the mechanic to obtain a solution to the question of how much work can vital energy do when operating through the means of such apparatus as is thus supplied. The muscles are so varied in form, combination, and number, that but little progress has hitherto been made to deduce results and bring them into measurement.

Now, no substance is known that can act the part of a muscle. A muscle left free is in the state of an india-rubber band when slightly stretched. It is called into action by contracting—exactly the converse to that of india-rubber, which is brought into action by being stretched. A number of these fibres are put together, and form a group like a number of india-rubber bands. Sometimes the groups act in a straight direction, sometimes they take a sloping form. If they take a straight form, and if we know the number of fibres and the power of endurance of one, it is easy to calculate the power of the whole; but, if the muscle acts diagonally, then it brings in the parallelogram of forces, and we need the mathematician to deduce the amount of energy which can be utilised by this form. Sometimes the fibres are twisted like a screw, sometimes they spring from one point and spread out like a fan, and all these screws and fans the mathematician must get hold of and calculate; this is now being done.

Having endeavoured very briefly to explain the mode in which animal vitality can be utilised through the agency of muscle, it may perhaps be well to state that between that part of the system where the will is localised and the muscle, there are telegraphic ramifications of nerves. These nervous processes enter within the muscle, and, by some means unknown to us, influence the muscle to exert its mechanical powers—convey, in fact, the will to that agent which is expected to do its bidding through the power introduced by vitality.

With this nerve power we are not concerned. The nerve as a material substance is intermediate between the will and the muscle; it has nothing to do with the amount of work done; its business is chiefly to connect the menta l and the material processes of life. Of that which is the will, of that which travels along the nerve in consequence of the will, we know nothing. Call it electricity; that is not any advance, for we know nothing of what electricity is. The first region in which the vital power gives a measurable evidence is when the muscle begins to act. Prior to that all is speculation, and furnishes a very pleasant hunting-ground for physiological enthusiasts.

Whether muscle is a means or apparatus for the transformation of force, or whether it is the material out of whose chemical changes or electrical states force and consequent energy result, are beyond our present knowledge. A plant transforms light into energy; so may muscle transform what, for want of a better name, may be called vitality into energy, and yet not be itself consumed or destroyed. Although, for obvious reasons, that energy which is localised in animals is called the energy of vitality, yet it must not be inferred that such energy or source of energy is self-existent. The animal extracts it in those wonder-working laboratories, the stomach and the lungs. By some unknown process it is deposited in the muscle as potential energy, and awaits the decision of the will as to when and how it shall become kinetic. Although ignorant of the analytical chemistry of vitality, yet we are not ignorant of the materials with which it experimentalises. With this knowledge we must rest; we cannot repeat the experiments vitality makes. Given every material and contrivance within reach, neither the physicist nor chemist, separately or jointly, can accomplish the phenomena with which the changes of these ingredients are concerned when they are associated with the vital principle.

To form an estimate of the number of the fibres in any muscle is an investigation requiring more of care and caution than of difficulty. Determining from a series of averages the magnitude of one—*i.e.*, the area of cross section of one muscular fibre,—and knowing the area of

the section of muscle, the number is merely the quotient of the division.

The muscles are exceedingly small and delicate, and the way their size is calculated is by cutting a piece of cardboard exactly to the section of the muscle. Then another piece is cut out of the same cardboard to, say, a square form, and they are weighed against each other until the square card is exactly the weight of the irregular piece. Thus, when the weights are equal, the areas are equal, and, by calculating the area of the square piece, you are able to arrive at the area of the section of the irregular muscle. By the aid of a powerful microscope, we can ascertain the size of a section of one of these fibrillæ, and it is found to be in men $\frac{1}{3500}$th of an inch in diameter, so that in an inch there would be 350 of them; in women it is about $\frac{1}{4500}$th, *i.e.*, in 1 inch there would be 450 of them. It may here be mentioned that these elementary fibres are not circular, but polygonal, owing to their mutual pressure, and at the angles of the polygons are the vessels which supply blood. Hence it obviously follows that where these fibrillæ are very small, the supply of the blood, which is the food of the muscle, can get at them more readily than when they are very large. Where they are large they have greater strength, that is, can lift heavier weights, but where they are small they will have greater endurance, because more freely and easily supplied with blood. Hence, as they are smaller in women than in men, the muscles of women have more power of endurance, but not the same strength as those of men. If a man wishes to test this, he has only to nurse a child, and then compare the length of time he could do so without fatigue with the length of time for which a mother can nurse it, and he will soon find the difference, and give a verdict adverse to himself.

There are two muscles in the arm, with which we are especially concerned in estimating the measurement of such vital energies as we may utilise; indeed, it may suffice to consider that the muscles in the arms and legs are the only ones to which the subject of this evening's lecture directs attention, and we may illustrate the question of the great number of muscular fibres by calculating, in the mode described their presence in the two most important muscles in the arm—viz., the one called "biceps," the other called "brachialis anticus." In the biceps there were found to be 449,000 elementary fibres; in the brachialis there were found to be 349,000; total, in these two muscles of the arm, 798,000 fibres.

(To be continued.)

NOTICES OF BOOKS.

Programm der Kœniglichen Rheinisch-Westphälischen Polytechnischen Schule zu Aachen fur den Cursus 1873-74.

Announcement of the Stevens Institute of Technology, a School of Mechanical Engineering founded by Edward A. Stevens. Hoboken, N.J., U.S.A. 1873.

We owe to the courtesy of the directors of the establishments just alluded to the opportunity of calling attention to two excellent schools established, the one by the care of the Prussian Government, the other by the munificence of a late eminent citizen of the great Transatlantic Republic.

In the Programme of the Polytechnic School at Aachen (Aix-la-Chapelle) we meet with a very clear and succinct review of polytechnic science in all its bearings and applications, as taught by a staff of some forty teachers, while the headings of the various subjects in which instruction is given amount to about one hundred. The school is now attended by about four hundred pupils, many of whom are natives of non-German countries.

Although an institution due to private munificence, the Stevens Institute of Technology can worthily vie with the now already celebrated School at Aachen. The Stevens Institute is just as much a high polytechnic school as the German one, and to the eminent President of the American school, Dr. H. Morton, high credit is due for the manner in which he has assisted the trustees of this foundation to carry out the will of the late Mr. E. A. Stevens.

Our space does not permit us to enter into a detailed review of the two volumes, the titles of which are recorded above. Both books have a permanent value, and the American contains, aided by woodcuts, a description of some of the most prominent portions of the contents of the museums and collections of apparatus for illustrating lectures on physical, chemical, and engineering sciences. While calling attention to these institutions, we cannot but express our great regret that in this country nothing exists which even approaches either of the two establishments of which the programmes have been courteously sent to us.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, August 4, 1873.

Reciprocal Displacements among the Hydracids.—M. Berthelot.—It is known that the reciprocal displacements among the hydracids are generally the reverse of those which take place among the corresponding elementary bodies. Chlorine expels bromine from bromides, which in turn drives out iodine from iodides, whether soluble or insoluble. But hydrobromic acid decomposes chloride of silver and alkaline chlorides, and hydriodic acid decomposed both the chlorides and bromides of silver, and of the alkaline metals. There is a similar contrast with oxygen and sulphur. This reversion of phenomena the author explains by the reversion of the thermic sign of the reactions. He has examined, both from a chemical and thermic point of view, the reactions of hydrochloric, hydrobromic, hydriodic, hydrocyanic, and hydrosulphuric acids upon oxides, and upon alkaline and metallic salts, as well as their reciprocal displacements. He finds that the thermic action of the three halogens gives place to reactions more closely alike to each other in case of silver than of potassium. The resemblance is still closer with mercury. It cannot be admitted that the mutual substitution of halogens gives rise in general to thermic effects which are constant, or even multiples of one common constant. On the contrary, such an approximate constancy exists with the salts of the alkaline metals, and with the acid chlorides, bromides, and iodides derived from certain non-metallic elements or organic compounds.

Polychromic Photography.—L. Vidal.—The process by which the author has obtained polychromic images is an extension of the "carbon process," described in his application for a brevet, December 23, 1872. For stearine paper he has substituted a vegetable paper coated with gum-lac. Polychromic proofs may be obtained either by optical means more or less precise, and analogous to those described by Ducos du Hauron, or by reserving on each of a series of monochromic proofs all the parts which ought to contribute, by a greater or less degree of transparency, to the formation of the monochrome. In copying nature, if it is desired to produce the red monochrome,

everything is covered with an opaque resist, such as vermillion or lamp-black, which contains neither red nor combinations of red with other colours. A similar process is repeated with blue and other colours. Each of the proofs concurring in the formation of a polychromic plate is then printed on a mixture of the desired colour, and developed on a provisory support.

Analysis of Dewalquite from Salm Chateau in Belgium.—F. Pisani.—This mineral has been known also under the names of ardennite and mangandisthen. Its composition is—

Silica	28·40
Alumina	24·80
Ferric oxide	1·31
Manganic oxide	25·70
Lime	2·98
Magnesia	4·07
Oxide of copper	0·22
Arsenic acid	6·35
Vanadic acid	3·12
Water, and loss on heating	5·20
	102·15

On Nitrification.—Th. Schlœsing.—(Continuation.)—If there is no oxygen in the atmospheric air confined in the soil it becomes a reducing medium, and the nitrates are doubtless destroyed, though the nature of their products of decomposition is not known. Kuhlmann has proved that nitric may be converted directly into ammonia. On the other hand, liquids of organic origin—such as the juices of beet-root, tobacco, or urine—yield a variable mixture of protoxide and binoxide of nitrogen, and free nitrogen. The decomposition products of the nitrates are therefore not constant, and depend on the nature of the surrounding medium. The mode of the decomposition of the nitrates, when the medium is a soil deprived of oxygen, has not been examined, and is a very interesting question. Earth of known composition mixed with known amounts of nitrates, and kept from November 20, 1872, till January 24, 1873, at temperatures ranging from 14° to 22°, showed that the reduction of the nitrates had not yielded 1-15th of the ammonia which would have been its equivalent; on the contrary, there is disengagement of free nitrogen. In another experiment earth kept in an atmosphere free from oxygen lost as much nitrogen as was originally present in the form of nitrate, and even more. Boussingault has shown that in a confined oxygenated atmosphere gaseous nitrogen does not contribute to the formation of nitric acid in soils; but that these, on the contrary, lost a portion of their combined nitrogen. The author finds the same result in an atmosphere void of oxygen.

Corundum of North Carolina, Georgia, and Montana.—Lawrence Smith.—In North Carolina corundum is found in rocks of chrysolith or serpentine, lying parallel to and on the north-west side of the main mass of the Blue Mountains. On the beds of serpentine are found chalcedony, chromite occasionally, chlorite, talc, steatite, anthophyllite, tourmaline, emeryllite, epidote, zoisiste. albite, asbestos, picrolite, actinolite, and tremolite.

Essence of Roman Chamomile.—E. Demarçay.—The author finds that this essence is a mixture of several ethers, among which the angelates and valerianates of butyl and amyl predominate.

Characteristics of the Polyatomic Alcohols, properly so-called.—M. Lorin.—The author considers that the property of producing oxamide may serve to recognise and define the chemical function of an alcohol, whatever may be its atomicity. The polyatomic alcohols, properly so-called, decompose above 100° common oxalic acid into water, carbonic acid, and formic acid. They combine successively with a part of the formic acid; and yield finally, on the one hand, a formine of the alcohol employed, and on the other, aqueous formic acid.

Variations in the Excretion of Urea under Normal Diet, and under the Influence of Tea and Coffee.—E. Roux.—The author finds that in his case, at least, coffee and tea do not hinder the wear and tear of the tissues. Their effect seems, however, to diminish the longer they are used.

M. Vicaire's Physical Theory of the Sun.—M. Faye.—M. Vicaire's theory is, briefly, as follows:—The sun is a combustible mass burning (since a certain epoch) in an immense atmosphere of oxygen; which must extend beyond Mars' orbit, the tails of comets being produced by it. The central mass consists of metals chiefly, with hydrogen and carbon in combinations permitted by a comparatively low and constant temperature. It is liquid (at the surface at least), and gives off vapours which burn in the oxygen, producing the photospheric mass of flame with a temperature much higher than the interior. This temperature keeps constant in the same way as that of a candle flame. The products of combustion are partly gaseous (water, carbonic acid, &c.), partly solid (silica, earths, metallic oxides). The latter along with carbon, where oxygen is not in excess, produce the bright light of the photosphere. The oxidated matters floating at the surface of the photosphere unite in large scorial masses, and fall into the interior liquid sea, producing the various phenomena of faculæ, spots, and protuberances. M. Vicaire supposes our earth—primitively formed of combustible matter, and surrounded with pure oxygen—to have taken fire and burnt some time. The arrest of the combustion would leave such products as we find. This hypothesis he transfers to the sun. In his criticism M. Faye, citing Laplace's hypothesis, thinks it impossible that in the period of cooling the chemical actions should have been completely suspended; so that there should be this absolute separation between metals so readily oxidised (even in cold), and a vast reservoir of free oxygen. Further, the enormous extent of the oxygen atmosphere is a difficulty. Laplace held the sun's atmosphere could not reach the orbit of Mercury (as the outer layer could not extend beyond where centrifugal force balanced gravity). If the products of combustion become gaseous, and are diffused throughout an atmosphere more than 110,000,000 of leagues diameter, the sun ought to become a source of cold. If, on the other hand, the products are solid, the constant passage of oxygen towards the nucleus must generate heat; but then there must also be an angular acceleration of the envelope producing this, and not a retardation, as is supposed. There remain physical and mechanical difficulties connected with the presence of four planets, &c., within the huge atmosphere. The intensity and duration of solar radiation are against the hypothesis; the heat would not last with constant intensity longer than historic times. The candle comparison is not exact; for in the sun it is supposed that the solid products of combustion fall incessantly on the surface of supply, while the gaseous products progressively vitiate the atmosphere. A sun so constituted would soon be encrusted and extinguished, instead of lighting and heating our earth during immense periods. Then it is difficult to conceive how the pulverulent and light oxides, arising from combustion of calcium, magnesium, &c., agglomerate in those huge blocks; remaining suspended till they acquire sufficient density and volume to produce by their fall spots, faculæ, &c.; and how do such incandescent masses produce indifferently dark spots and bright faculæ? These scoriæ, moreover, are not supposed to be thin pellicles, but enormous rigid masses capable of resisting for entire months the ebullition of the metallic ocean, and of intercepting the vapours which seek exit by their edges, and thus, M. Vicaire thinks, produce penumbræ. M. Faye thinks the vertical section of a spot is entirely against this idea. He concludes with a *resumé* of eight different theories of the sun's constitution.

Determining the Wave Lengths in the Infra Red Part of the Spectrum by means of the Effects of Phosphorescence.—M. E. Becquerel.—M. Fizeau has shown that if a thin plate (mica, *e.g.*) be put before a slit

admitting solar rays from a heliostat into a dark room, there appear interference bands in the spectral image. Their number between certain limits is related to the wave lengths of the corresponding rays. They are very indistinct, however, the direct and twice-reflected rays having different intensities. M. Becquerel substitutes for the metallic plate of the heliostat a thin plate of mica on a plane non-reflecting surface. The rays reflected from the two surfaces of this plate have comparable intensities, and the bands are alternately bright and dark. One such plate, having a thickness less than $\frac{3}{100}$ of a millimetre, gave 11½ fringes between the lines B and D of the solar spectrum. A somewhat thicker plate gave 35; but for phenomena of phosphorescence the number should be less, and the mica not more than $\frac{1}{100}$ m.m. thick. The phosphorescent substances, pulverised, are submitted to the spectrum thus crossed by interference bands. In the ultra violet the parts unequally active are distinctly shown; in the infra red they are less distinguishable, and very thin mica plates should here be used, as also a brightly phosphorescent substance like hexagonal blende. M. Becquerel finds wave lengths in some parts of the infra red exceed the double of the extreme red. But he does not yet furnish details.

Use of Armatures applied to Magnetic Bundles.—M. Jamin.—If several magnetised plates are superposed they react on each other, each destroying, in part, the magnetism of its neighbour; so that the portative force of the bundle is less than the sum of the forces of the plates considered separately. M. Jamin has found a means of preventing reaction and weakening for a time. He magnetises each plate separately; applies to it a well-fitting contact of the same thickness, which neutralises it; then superposes plates and contacts, fixing with screws the magnets together and the contacts together. This does not destroy the neutrality of the elements, but hinders their reaction. Thus to detach all the contacts a weight of 115 kilogrms. was necessary, or a little above the sum (108) of the individual forces. Immediately the contacts are detached the plates cease to be neutralised; their magnetism reappears; they react on and weaken each other as before. Superposed plates with an armature are less charged (magnetically), and so react less on each other. Armatures weaken the magnetic intensity; their part is to offer a space where magnetism may collect and be preserved, which would otherwise be destroyed in consequence of mutual reaction between the constituents of the bundle.

Cubic Space and Volume of Air necessary to Ensure Healthiness in Inhabited Places.—Gen. Morin.—The author gives a formula indicating what amount of air should be renewed hourly for each individual, in order that carbonic acid and vapours exhaled may not accumulate beyond a proportion of 0·0008 in a given enclosed space. He finds that in a cubic space of 10 cubic metres this renewal hourly should be 90 cubic metres; in 12, 88; in 16, 84; in 20, 80; in 30, 70; in 40, 60; in 50, 60; in 60, 40. Various applications of the formula are suggested—barracks, bedrooms, public halls, hospitals, &c.

Direct Demonstration of the Fundamental Principles of Thermo-Dynamics.—Continued extract from memoir by M. Ledieu.—The author here treats of the calorific energy and equilibrium of bodies; and gives a demonstration of the principle of mechanical equivalent of heat.

Memoir on Cerebral Localisations, and on the Functions of the Brain.—Dr. Fournié.

Maximum Resistance of Magnetic Coils.—Fourth note by M. du Moncel.—The author has shown in these notes—(1) That a given helix produces its maximum effect when its proper resistance is greater than that of the exterior circuit in the proportion of 1 to $1+\frac{c}{a}$; (2) that with the same diameter of coil the helix giving the best results is that in which the wire has such thickness and length that its resistance represents that of the exterior circuit; (3) that the thickness of magnetic helices should be equal to the diameter of the magnetic cores they surround; (4) that their length should be equal to this diameter multiplied by 11, or, practically, by 12.

Electrical Condensation.—Extract from memoir by M. Neyreneuf.—The air surrounding an electrified body experiences, like all insulating bodies, the effect of penetration in the nearest molecules, and of orientation in the more remote. The former act, in the production of a spark, not by direct transmission, but like the insulating plate of a condenser, *i.e.*, by decomposition, by induction.

Uniformity of the Heart's Work when this Organ is not Subject to Exterior Nervous Influence.—M. Marey.—The author removes the heart of a tortoise, and adapts to it a system of fine caoutchouc tubes, representing arteries and veins. On contracting the artificial artery, and so increasing the resistance, the heart's movements are retarded; on lessening the resistance the beats are accelerated.

Effects Produced by Lightning at Troyes, on July 26, 1873.—M. Parent.—One interesting feature is the appearance of several balls of fire. One falling before a young woman rolled along the street, then disappeared; while hair pins, and other pieces of metal about her person, were violently torn out. Other incandescent bodies were afterwards found in a cooled state; one was like a piece of calcined stone, but was surprisingly light; some parts of it were dirty grey with black points, others reddish with bright reflection. The lightning produced some curious effects on a public building in the place.

Bulletin de la Societe Chimique de Paris, tome xx., No. 3, August 5, 1873.

In the session of July 4 M. Prud'homme communicated some facts relating to rosolic acid. When phenol is heated with sublimed oxalic acid to 110° to 120° there is obtained a body which dissolves in water, and deposits in the form of a red powder. The solution dyes wool and silk like rosolic acid. The alkalies turn it to a rose colour. On heating to 180° we obtain rosolic acid, which precipitates in water as a green powder. The red powder and the rosolic acid yield with hydrosulphite of soda colourless compounds, soluble in water and alcohol. The combination which rosolic acid yields should be identical with that which Dale and Schorlemmer have obtained with the bisulphites. Schützenberger has shown the identity of the compounds formed by the hydrosulphite and the bisulphites with the hydride of benzol.

On Tereben.—M. J. Riban.—The author describes the preparation of tereben; its properties, its transformation into polymers, and into cymen, and the production of a camphoric matter.

Heat of Combustion of Formic Acid.—M. Berthelot.—This paper treats also of the heat of combustion of oxalic acid; of the heat developed by the reduction of permanganate of potassa, and of the oxidation of formic acid. It may be regarded as a continuation of the Berthelot-Thomsen controversy.

Researches on Chlorine and its Compounds.—M. Berthelot.—Another thermo-chemical controversial paper. The author examines the action of chlorine upon water, upon the mercurous and stannous chlorides, and ferrous sulphate.

Compound of Picric Acid and Anhydrous Acetic Acid.—D. Tommasi and H. David.—By the mutual reaction of these two bodies a compound is obtained of the formula—

$$\left.\begin{matrix} C_6H_2(NO_2)_3 \\ C_2H_3O \end{matrix}\right\} O$$

which may be regarded as a picrate in which the atom of metal is replaced by acetyl.

Glycerin of the Aromatic Series.—Ed. Grimaux.—The substances examined are—dibromhydric stycerin; aceto-dibromhydric stycerin; tribromhydric stycerin; hydrochloric-dibromhydric stycerin; triacetic stycerin; and pheno-glycerin.

Process for the Quantitative Determination of Aniline Colours by Means of Hydrosulphite of Soda.—A. Stamm.—Up to the present time there has been but one process for determining the value of a colouring matter. It consists in dyeing or printing with the different samples, and comparing the intensity of the shades produced. This method answers perfectly for industrial purposes. But there exists no chemical procedure for determining these bodies, and proving their purity. The author considers that he has effected this object with simplicity and precision, by making use of the power which hydrosulphite of soda possesses of reducing and decolourising different tinctorial bodies, and, amongst others, those derived from aniline. The apparatus employed is essentially the same as that which Schützenberger and Risler employ for the determination of oxygen dissolved in water. The hydrosulphite is drawn up by aspiration into a Mohr's burette. The solution to be titrated is poured into a small flask closed with a caoutchouc stopper, pierced with three holes. Through one of these passes the delivery-tube of the burette, whilst the other two serve for admitting into the flask a current of carbonic acid gas, since the experiments must be made in the absence of atmospheric air. Lastly, as the decolouration of these matters only takes place at 100°—except in case of magenta which is decolourised in the cold—the flask is placed on a sand-bath, and the contents kept at the boiling-point. If it is required, *e.g.*, to analyse a sample of magenta, we weigh out 1 to 2 decigrammes, which are dissolved in water and diluted to a litre. At the same time a solution is prepared of 1 or 2 decigrms. of pure magenta in a litre of water. All that is required is to determine how many degrees of the hydrosulphite are required to decolourise each of these solutions. The ratio of the two numbers gives the value of the solution under examination. Other colouring matters have been titrated, and on comparing the results obtained it is found that 1 molecule of each of these different bodies whose composition is known requires for its decolouration the same quantity of hydrosulphite as would be consumed in reducing 2 molecules of ammoniacal sulphate of copper. This method offers another advantage—it enables us to judge of the quantity of colouring matter contained in an unknown liquid. It may be also used during the manufacture of aniline blues and violets to ascertain the amount of colouring matter which has been formed.

Compounds of Chloride of Titanium with the Ethers.—Eugène Demarçay.—The chloride of titanium is capable of combining with the oxygenated ethers, and with the alcoholic sulphides and hydrosulphites. With acetic ether it forms three compounds, as also with benzoic ether, with the butyrate, valerate, caproate, and angelate of ethyl, the valerate and acetate of amyl, and the benzoate of methyl. The ethers formed by bibasic acids furnish analogous compounds, but less stable. Oxalic and succinic ethers give two compounds. In constitution these compounds may be considered as chlorhydrines analogous to the silicic chlorhydrines of M. Friedel, united to the chlorides of acid radicals.

Manufacture of Gelatin.—M. F. Heuze.—The author's object is to obtain white gelatin from products of low quality. He attempted first to bleach the brown or nearly black gelatin, which is obtained as a secondary product in the manufacture of neats'-foot oil. This gelatin is applicable to very few uses on account of its dark colour, and is sold at 42 francs per 100 kilos. To prepare it, the feet—after removal of all parts useful for the turners—are digested in water or superheated steam at a pressure of 3 atmospheres. After three hours of digestion, and half-an-hour for settling, the strongly ammoniacal solution of gelatin is concentrated; the supernatant oil having been previously removed. A dark brittle gelatin is thus obtained. The author tried to bleach it with sulphurous acid, or with a sulphate in presence of hydrochloric acid, but the results were unsatisfactory. He attempted then to modify the process of manufacture itself, diminishing the duration of the action of the superheated steam. Instead of drawing off all the liquor at the expiration of three hours, it was drawn off three times from hour to hour. The solution was then mixed with wood charcoal mixed with 25 per cent of animal charcoal, and after standing twelve hours was treated as above. The solution requires 4 per cent of the charcoal mixture. The product is a gelatin of good quality, which only presents a yellow tint when seen in large masses. It is tasteless and scentless, and is even fit for alimentary purposes.

Waterproof Glue.—Bichromate of potassa has the property of rendering insoluble, under the influence of light, certain organic bodies, such as gum, glue, glycerin, &c. If a paper covered with gum mixed with bichromate is exposed to light, the coating becomes quite insoluble even in boiling water. This property is utilised in the so-called "carbon" photographic process. Strong glue becomes insoluble more rapidly than gum, and the action takes place slowly even in the dark. A concentrated solution of bichromate is prepared which is kept in the dark, and a little of which is added to boiled gelatin. Objects glued with this, after some time can be washed either with cold or hot water.

Preparation of Parchment Paper.—M. J. Stinde.—The paper is prepared with the chromatised gelatin mentioned above. It serves in the preparation of the pea-sausages used in the German Army.

Improvements in Photo-Lithography.—M. Paul.—The paper is coated with a layer of white of egg beaten up and mixed with a concentrated solution of bichromate. When dry it leaves a hard smooth surface. After a sufficient insolation under the negative, the paper is covered with lithographic ink, then immersed in cold water to dissolve out the unchanged albumen, which is then removed with a fine sponge.

Bulletin de la Société Française de Photographie.
No. 7, 1873.

M. Despaquis presented to the Society proofs in Judea bitumen, mounted between two cards with an opening, and visible either by transmitted or reflected light. These proofs are stable, of a low price, fine in details, and have a pleasing sepia tone.

M. Briois, on behalf of M. de Sars, submitted to the Society a simple instrumennt, by means of which dried plates may be changed in full daylight.

Preparation of Albumen Plates by a Modification of Gaumé's Process.—M. Clouzard.—The author employs the following collodion:—

Ether	50 c.c.
Alcohol at 36°	50 c.c.
Soluble cotton	0·70 grm.

To prepare the albumen the author dissolves in 40 c.c. of water:—

Gum arabic in powder	2·5 grms.
Milk-sugar	1·0 ,,
Iodide of ammonium	3·0 ,,
Bromide of ammonium ..	1·0 ,,

This solution is added to 100 c.c. of albumen dissolved in acetic acid according to M. Acloud's directions, and the whole is carefully filtered before use. The plates being prepared with the collodion and albumen, and well dried before being rendered sensitive, are submitted to the vapour of iodine for thirty seconds, when the temperature is from 18° to 20°.

Silver Bath.

Water	90 c.c.
Acetic acid	12 c.c.
Nitric acid	4 c.c.
Nitrate of silver	10 grms.
Iodide of ammonium	0·10 grm.

The precipitate of iodide of silver formed is left for some time in the solution, and stirred in order to saturate the liquid as much as possible. To render the plates sensitive they are immersed in this bath for a minute and a-half if the temperature is 18° to 20°.

Developing Bath.

Water	100 c.c.
Liquid ammonia	1 c.c.
Alcohol	2 c.c.
Water	100 c.c.
Bromide of potassium	0·25 grm.

1 volume of the second solution is mixed with 3 of the former; and this mixture is poured upon the plate previously moistened. The liquid is re-collected in a glass, and pyrogallic acid is added in the proportion of 0·5 grm. to 100 of the liquid employed. When the pyrogallic acid is dissolved the solution is again poured upon the plate, when the image appears in full detail if the exposure has been sufficient.

Application of Aniline in Photography.—M. Trouquoy.—This process has been previously noticed.

New Method of Removing Hyposulphite of Soda from Proofs on Paper.—M. Hermann Gunther.—The quantity of water needful for washing the proof may be diminished, and a better result obtained by using a solution of eau de javelle (hypochlorite of soda). In practice the proofs, after fixing, are washed in three successive baths of pure water. They are then passed into water containing a few c.c. of eau de javelle, and finally washed in pure water.

Suppression of Gold in Toning.—M. Bodgers.—The author prepares his silver bath at 6 per cent, and adds 10 drops of ammonia, and 10 of a saturated solution of alum per litre. On this bath the paper is floated three to five minutes according to the temperature. The impression is feebler than if chloride of gold had been employed. After exposure the proofs are washed for fifteen to twenty minutes, and then plunged in the following bath. Into ½ litre of water press the juice of five lemons, add 15 grms. acetate of soda, and 7·5 grms. of powdered alum, dissolve and filter. Pour 15 to 30 grms. of this solution into 2 to 4 litres of water; plunge the proofs into this bath, and let them remain five to ten minutes. Then submit them to the ordinary toning bath, substituting for the gold alum water in the proportion of 20 drops per litre of water. Let them remain two or three minutes only. Wash again, and fix with hyposulphite mixed also with alum (15 drops per litre of water).

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxi., No. 15, August 7, 1873.

Artificial Sugar.—The *Assemblee Nationale* promulgates a rumour that M. Jouglet has succeeded in forming sugar artificially, and at the low price of 5 francs per 100 kilos.

No. 16, August 14, 1873.

Prevention of Epidemics.—M. Chodzko.—The author declares that the phenols, the hypochlorites, and chlorine merely mask deleterious emanations without destroying them. He professes to have discovered a means of disinfection which neutralises all putrid effluvia. The process can be executed with rapidity, and costs only 10 centimes per cubic metre. (Unfortunately no indication is given as to the nature of this new disinfectant.)

Action of Iodine upon Caoutchouc.—M. Baumetz.—India-rubber tubes, whether vulcanised or not, if submitted to the action of iodine increase rapidly in bulk, and grow hard and brittle.

Double Phenomenon of Incandescence by Oxidation and Reduction.—M. Thomsen.—A cylinder is made of oxide of copper and gum-water. When dry it is reduced at a low temperature in a current of hydrogen. If while still hot this cylinder of reduced copper is placed in an atmosphere of oxygen it becomes immediately incandescent, and remains so till the oxidation is complete. If while still hot it is transferred to an atmosphere of hydrogen, a new incandescence takes place, due to the reductive action of the hydrogen.

Agricultural Value of the Human and Animal Excrement Annually Produced in France.—Taking into account merely nitrogen, phosphoric acid, and potash we find the following values:—

	Head.	Frs. c.	Francs.
Human	36,000,000 at	15·13 =	544,680,000
Oxen, &c. ..	10,000,000 at	181·94 =	1,819,400,000
Horses	2,000,000 at	132·74 =	398,200,000
Sheep	35,000,000 at	15·38 =	538,300,000
Swine	6,000,000 at	23·55 =	141,300,000
			3,441,900,000

The total amount of nitrogen contained in the excrements is 1,141,950,000 kilos.; which, at 40 kilos. per hectare annually, would manure all the cultivated lands in France, amounting to 27,476,000 hectares.

Polytechnisches Journal von Dr. E. M. Dingler, No. 5, 1873.

Investigations on the Solution of Gases in Cast-Iron, Steel, and Wrought-Iron.—L. Troost and P. Hautefeuille.

Recovery of the Gold which is Carried off along with Chloride of Silver during the Process of Refining with Chlorine.—Ad. Leibius.

Coal-Tar and Pitch.—E. A. Behrens.

Determination of Alcohol in Fusel Oil.—G. L. Ulex.

Respiration and the Internal Air of Beet-root.—A. Heintz.

A Fruitful Source of Ammoniacal Salts.—Bruno Terne.

Removal of the Refuse of Towns.

MISCELLANEOUS.

The Adulteration Act.—Mr. Wanklyn has been appointed Public Analyst to the County of Buckingham.

Photographer to the Shah.—We learn that Mr. A. J. Melhuish, F.R.A.S, has received the honour of special appointment as Photographer to His Imperial Highness the Shah of Persia, the reason assigned by the Shah for conferring this honour being that he had never had portraits which pleased him so much, although he had sat to artists at St. Petersburg, Berlin, and Paris.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of artificial manure. Edward Charles Hamilton, Colchester, William Richard Preston, Harold Court, Romford, and Henry Jones, Colchester. January 16, 1873.—No. 187. According to this provisional specification, sewage is mixed with or filtered through waste wool, wool dust, or shoddy; the materials are brought to a pulverulent form.

Improvements in the manufacture of gas. Miles Williams, Lion Oil-Works, Wigan. January 17, 1873.—No. 205. This invention consists in forcing steam and oleaginous substances, more particularly hydrocarbon oils together, through an ordinary red-hot fireclay or iron retort filled or partially filled with coke, charcoal, or other similar substances. The gas so generated may be used, either alone or mixed with ordinary common coal or cannel-gas generated in the usual manner the result being a better and more economically produced gas.

An improved process of gilding on glass. Valentin Schwarzenbach, Professor of Chemistry at the University of Berne, Switzerland. January 18, 1873.—No. 208. Take a solution of pure gold, that is to say, free from all other metals, effected by the ordinary chemical process. When pure gold is employed, the work is simple, since it is merely necessary to melt it in aqua regia or nitro-muriatic acid, and to evaporate it in the bain marie till it crystallises; in all other cases the operation is more complicated, on account of the manipulations necessary for separating the other metals, and it is generally requisite to precipitate the gold once by oxalic acid or by sulphate of iron, to bring it to the desired state of purity. In all cases the crystallised mass of perchlorate of gold should be brought to boiling-point with the water destined for its solution, as it invariably contains a considerable quantity of chloride of gold insoluble in water, which slowly decomposes in a cold state, very gently in perchlorate or in metal, but which is instantly effected by coction. After filtration, the solution of gold is ready for use; its dephlegmation is regulated so that 200 c.c. contain 1 grain of metallic gold. This solution is then rendered alkaline by soda lye of mean strength, that is to say, a sufficient quantity is added to it to turn red litmus-paper blue; the addition of the soda should not cause any precipitate, and should never trouble the auriferous liquor; the quantity of soda must necessarily vary according to the dephlegmation of the solution. Before mixing the gold solution with the principal reactive destined to the reduction of the metal, it is indispensable to prepare the surface of the glass to be gilt with the greatest care, employing the same manipulations and materials used for cleaning photographic glasses; the reactive reductive is then prepared by saturating 30 per cent of spirits of wine with a current or mixture of marsh-gas or olefiant-gas; this operation completed, the spirits of wine is freed with its volume of distilled water. The glass to be gilt is then disposed horizontally on another surface of glass, separated from it about the space of 3 m.m.; then 25 c.c. of alcohol saturated with the gases is mixed with the auriferous solution; the liquid is then poured between the two glasses, and then left to stand for 2 or 3 hours, at the expiration of which time the gilding is completed. The upper gilt plate is then removed, carefully washed, and varnished.

Improvements in the manufacture of meat extract. Thomas Frederick Henley, St. George's Square, Pimlico. January 18, 1873—No. 212. The object of this invention is so to treat meat for obtaining meat extract as to utilise all the elements of its composition instead of (as in the Liebig process) utilising only the soluble salts thereof.

NOTES AND QUERIES.

Pure Anthracen.—I should be glad if your readers would inform me of the best way of preparing crude commercial (say 30 per cent) anthracen, and also give me a good plan for the quantitative estimation of the same.—A. M. G.

"Charqui" and "Damper."—Permit me to call your attention as Editor to CHEMICAL NEWS, vol. xxviii., p. 65. "Charqui, or dried beef, the damper of the Australian squatter." This requires explanation, the word "damper" in Australia being applied to a cake of flour and water.—E. DOLBY.

French Imperial Green and Persian or Chinese Red.—I should feel greatly obliged if some of your readers would sketch briefly the cheapest commercial processes employed for the production of the following pigments:—(1). *French imperial green*, which appears to be a mixture of chrome yellow and Prussian blue, but which far surpasses in beauty all the ordinary chrome greens. (2). *Persian red*, sometimes called *Chinese red*.—This seems to be a dichromate of lead; but the original process of Liebig and Wöhler has, I believe, been superseded by much less expensive modes of manufacture. I have tried two processes mentioned in "Wagner's Technology" (English Edition, p. 66), viz., treatment of chrome yellow with caustic potassa solution, and Professor Dulong's process, but (perhaps through some fault of manipulation) I have failed to obtain a more brilliant colour than chrome orange.—I. HOWARD HUNTER.

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The NEXT ANNUAL GENERAL MEETING will be held at BRADFORD, commencing on WEDNESDAY, September 17.

President Designate:
Professor A. W. WILLIAMSON, Ph.D., F.R.S., F.C.S.,
In the place of J. P. JOULE, D.C.L., LL.D., F.R.S., who has resigned the Presidency in consequence of ill health.

NOTICE to CONTRIBUTORS of MEMOIRS.—Authors are reminded that, under an arrangement dating from 1871, the acceptance of Memoirs, and the days on which they are to be read, are now, as far as possible, determined by Organising Committees for the several Sections before the beginning of the Meeting. It has therefore become necessary, in order to give an opportunity to the Committees of doing justice to the several communications, that each Author should prepare an Abstract of his Memoir, of a length suitable for insertion in the published Transactions of the Association, and that he should send it, together with the original Memoir, by book-post, on or before September 1, addressed thus—"General Secretaries, British Association, 22, Albemarle Street, London, W. For Section...." If it should be inconvenient to the Author that his Paper should be read on any particular day, he is requested to send information thereof to the Secretaries in a separate note.

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THE CHEMICAL NEWS.

VOL. XXVIII. No. 719.

INVESTIGATION OF THE FLUORESCENT AND ABSORPTION SPECTRA OF THE URANIUM SALTS.*

By HENRY MORTON, Ph.D.,
and H. CARRINGTON BOLTON, Ph.D.

(Continued from p. 50).

PART II.

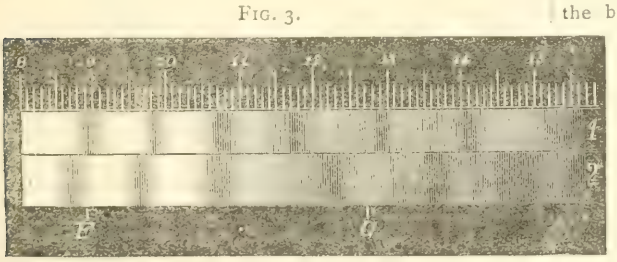
Absorption Spectra.

THERE are in the uranium salts two sorts of absorption—one directly related to their fluorescence, and the consequence of the fact that those rays which excite fluorescence must themselves disappear, their motion indeed simply taking that other form; and the other an absorption having no such immediate relation to fluorescence, but representing rays of the spectrum whose motions are converted into heat or some other form of force not sensible to the eye. This was observed by Stokes in the case of canary glass, and in the solution of the uranium nitrate (*Phil. Trans.*, 1852, pp. 497, 517). The absorption-bands of the second variety were studied by him in crystals of the nitrate of uranium in solutions of the double carbonates of uranium, and in yellow and green uranite (*Phil. Trans.*, 1852, p. 520).

Hagenbach† has also carefully measured both classes of absorption in the case of canary glass and uranium nitrate, and points out the distinction between the first, which is correlative with absorption, and the last, which is unaffected by solution, which almost destroys fluorescence.

As regards absorptions of the first class they are best studied by direct observation, combined with a process closely allied to that described by Stokes as his *third method*, which consists in throwing a pure spectrum upon a screen of the substance in question, or upon the vertical side of a tank containing a solution. With the solid screen, the location of general maxima of fluorescence will correspond with maxima of absorption, and with the tank the absorption can be directly seen as embodied in

FIG. 3.



dark blades or triangular masses of shade running into the tank (as seen from above) from the side away from the light. These appearances will often indicate the existence and relative intensity of absorptions, whose exact location we can measure by examining the transmitted light directly with the spectroscope in the manner represented in Fig. 3.

The spectra of absorptions not directly related to fluorescence is, as a rule, best studied by transmitted light, although in the case of solids two other methods give us accordant results.

First. When observing the fluorescent bands in the usual way, if the spectroscope is directed a little obliquely towards the bottle under examination (*i.e.*, a little to the right or left of its centre), many of the absorption-bands can be readily seen. This is specially the case with the acetates, the oxalate, the calcium phosphate, and some others.

Second. If a pure spectrum is thrown upon a screen prepared with a coating of uranium salt, the absorption-bands are very distinct, and their positions may be measured as follows:—A pin-hole is made in the screen, and this is moved laterally until the centre of a band falls on the pin-hole. Then the refrangibility of the light passing through this pin-hole is easily measured by a spectroscope placed behind the screen, and gives the exact location of the centre of the band.

As an example of the accuracy of this method I will give the measurements of the absorption-bands of uranic oxalate, as measured in the light transmitted by a layer of the salt in powder attached by a little water to glass, and as determined, by the method just described, on a screen of the same substance.

Absorption-bands of uranic oxalate:—

By transmitted light ..	50° 43′	51° 07′	51° 33′	52° 00
From a screen	50° 44′	51° 06′	51° 32′	52° 00′

The numbers here given are the direct readings on the circle of the spectroscope.* The two observations were, moreover, made at different times and by different observers, one set being made by Mr. Sorge, one of the students of the Stevens Institute of Technology. Many other measures even more accordant were obtained, but the above was selected as at once illustrating the ease and certainty of the observations by these methods. The method of measuring the bands by transmitted light has, however, always been employed in the first instance, and the other used only as a check and guide in doubtful cases.

The difference between different salts as regards their absorption-bands is very great, as a glance at Fig. 1 will show; and, while in many cases solution has a vast effect upon fluorescence, it sometimes (as Hagenbach remarked with the nitrate) produces but little effect upon the absorption-bands. In other instances, however, very marked changes occur, and, when these are followed out to their legitimate conclusions, they lead us to some very remarkable and not unimportant results. Thus, if we examine the absorption spectra of the uranic acetate and the various double acetates, we shall find that in the solid state they present great variety in the exact location of the bands, but in solution we have exactly the same spectrum for all. The conclusion naturally, therefore, presents itself, that in solution all are reduced to the same state, which could, of course, only be by the breaking up of all the double salts. Indeed, from this, supported as it is by other observations, we do not hesitate to conclude that *no double acetate can exist in solution in water*, but must break up into its two single salts. Nor do our conclusions stop here, but we must reserve others until some of the facts on which they are founded have been described. A similar experience leads us to a like conclusion in the case of the sulphates, oxychlorides, &c. Attention was drawn to the fact of such displacement by one of us in September of last year (*American Chemist*, 1872, p. 81), but its true bearing has only been perceived recently, since a large number of observations have been accumulated.

A change of character, rather than of position, produced by solution in the absorption spectrum of didymium sulphate, was observed by Bunsen in 1866 (see *Pogg. Ann.*, vol. cxxviii., p. 100, and *Phil. Mag.*, 4th series, vol. xxxii. p. 181).

The position of the band of uranium nitrate, while un-

* Communicated by President Morton.

† *Pogg. Ann.*, 1872, vol. cxlvi., p. 497.

* In this case 1° corresponds to 1·6 ths of a millimetre of the Bunsen scale.

affected by solution in water, is notably changed by other solvents, as the following table will show :—

Bands.	1.	2.	3.	4.	5.	6.
Glycerin	87·6	96·0	107·8	123·0	136·0	148·6
Water	89·8	98·5	108·5	118·7	129·5	142·0
Alcohol	—	99·4	111·7	—	—	—
Hydrochloric ether..	—	99·4	110·8	123·7	—	—
Ether	—	100·0	112·6	123·0	—	—
Acetic ether	—	101·0	111·7	128·0	135·4	—

These numbers are the averages of several sets of measurements, but the bands are in many cases very indistinct, and, in the case of the 4th band, much obscured by the Fraünhofer lines in the neighbourhood of G. The action of glycerin merits special notice, as compared with their positions in the solid; and in the aqueous solution all the bands below some point, about 110 of the scale, are depressed, while those above are elevated. Fig. 3 will make this evident at once.

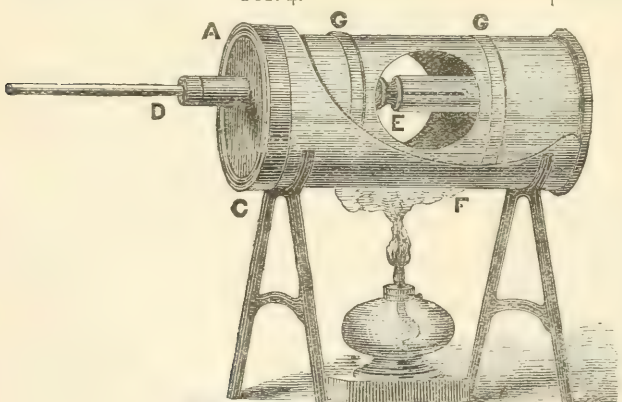
A change in position of the absorption and fluorescent bands of certain organic bodies, by change of solvent, was noticed by Hagenbach (see *Pogg. Ann.*, vol. cxlvi., p. 534), and he refers to researches by Kraus, published in the *Sitzungsber. der Phys. Med. Societät zu Erlangen*, July 10, 1871, in which that observer concludes that the denser the solvent the greater the downward displacement of the bands.

Effects of Heat.

It was observed by Stokes that canary glass and the nitrate of uranium had their fluorescence largely reduced by heating, and that at a temperature much below a red-heat their influence upon light in this respect was entirely suspended. He also noticed that in the solution of uranium nitrate the same effect followed from a moderate elevation of temperature, and near 212° F. had extinguished all fluorescence. In all cases the substance regained its fluorescent properties on cooling. He also remarked that no such action appeared in fluorescent vegetable solutions.*

Gladstone has made a series of investigations on the absorption spectra of solutions, among which is one in

Fig. 4.



which the effects of heat are considered. He finds that, as a rule, the effect of heat is equivalent to a concentration of the solution, and amounts to an increase in the amount of absorption.†

In a research "On the Change of Colour produced in Certain Chemical Compounds by Heat," Prof. E. J. Houston tested, among other things, a large number of solutions, and developed the curious fact—not before noticed—that in all cases where no chemical change was involved solutions as well as solids changed to tints lower in the spectrum by the application of heat.‡

* *Phil. Trans.*, 1852, p. 532

† *Phil. Mag.*, 1857, vol. xv. . .p. 423.

‡ *Journal of the Franklin Institute*, 1871, vol. lxii., p. 121.

The loss of fluorescence in a few substances when heated, which was noticed by Stokes, appears to extend (with certain limitations) to all the uranium compounds, both in their solid state and in solution.

We find that in the case of the anhydrous ammonio-uranic sulphate, fluorescence is sensibly diminished at 140° C., and is almost destroyed at 260° C. The hydrate does not show any marked loss of fluorescence below the point at which it begins to part with its water. The same is true of the potassium sulphate. The sodio-uranic acetate is, however, much more sensitive. Experiments were made with it and other salts in the following manner :—A small oven was made from a piece of brass tubing, about 5" long and 1·5" in diameter, closed with caps, one of which was provided with a tubular, c. Holes of 1" diameter were cut on opposite sides, and covered with thin plates of mica, D. The salt to be examined was then placed in a small specimen bottle, into which was passed the bulb of a thermometer, whose stem traversed the tubular, in which it was packed with soft asbestos. This apparatus was then substituted for the revolving stand, c, of Fig. 4, and the heating accomplished by a spirit-lamp, while the appearance of the bands was constantly observed.

Heat being thus applied to the sodio-uranic acetate, it was observed that at about 50° C. (122° F.) the brightness of the fluorescence was reduced, and that the uppermost decided band of fluorescence (81·8) lost its distinctness. As the temperature rose the amount of fluorescence gradually diminished, until, at about 110° C., it seemed to reach a minimum. It was also evident that the bands of fluorescence were displaced downwards in the spectrum by the increase in temperature, as will be fully shown by the following table of measures made at 19° C. (66·2° F.) and 116° C. (240·8° F.). At the higher temperature the uppermost band had entirely vanished, and the lower ones were too faint for measurement with the apparatus employed.

Fluorescent bands of sodio-uranic acetate :—

Bands.	1.	2.	3.	4.	5.	6.
At 19° C. (66·2° F.)..	41·0	45·0	53·0	62·4	72·0	81·8
At 116° C. (240·8° F.)	—	—	53·0	61·0	70·8	—

No appreciable further change was produced by carrying the temperature to 150° C. (302° F.), and on cooling everything returned to its original condition. Solutions are still more sensitive in this respect. In the case of the sodio-uranic acetate, which gives a highly fluorescent solution, a very marked reduction can be perceived at 71° C. (160° F.), while at 82° C. (180° F.) there is hardly any trace of this fluorescent action left. So, again, with the ammonio-uranic sulphate in solution. Its fluorescence is first notably diminished at 71° C. (160° F.), and is almost inappreciable at 77° C. (170° F.), although it can still be seen at 88° C. (190° F.). In fact, every solution of a uranium salt which has any sensible fluorescence loses it in great part by a rise of temperature quite inside of its boiling-point.

With a number of these salts, moreover, we have noticed another curious effect, namely, a depression of some or all of their bands of absorption, as well as an increase and lowering in the general absorption which affects the upper end of their spectra.

The double carbonates furnish the most striking examples which we have yet observed, but the double sulphates show it very distinctly, as does also the oxalate.

The nitrate shows in solution a marked increase in general absorption when heated, but no displacement of bands that could be recognised. This also seems the case with the acetate and double acetates.

The table (Displacement of Absorption-Bands by Heat) will give some idea of the character of this displacement in several instances :—

DISPLACEMENT OF ABSORPTION BANDS BY HEAT.

Solution of ammonio-uranic carbonate in water :—

Bands.	1.	2.	3.	4.	5.	6.
Cold, 24° C. (75° F.)..	101·2	113·1	123·7	133·4	144·0	153·0
Hot, 86° C. (186·8° F.)	102·6	112·5	122·0	131·2	142·8	152·0

Solution of potassio-uranic carbonate in water :—

Bands.	1.	2.	3.	4.	5.	6.
Cold, 24° C. (75° F.)..	103·0	113·0	123·8	133·8	144·4	153·0
Hot, 86° C. (186·8° F.)	101·8	111·7	122·2	132·0	142·8	152·0

Solution of sodio-uranic carbonate in water :—

Bands.	1.	2.	3.	4.	5.	6.
Cold, 24° C. (75° F.)..	102·2	112·2	123·2	132·2	144·8	152·4
Hot, 86° C. (186·8° F.)	101·5	110·8	121·4	131·0	142·8	—

All these carbonates seem in solution to be without the band which is given in their solid condition at about 93·7.

Other salts also show a similar depression of absorption-bands by heat. Thus, in the uranic oxalate we have a displacement which, though small, is unquestionable, as the following table will show.

Solution of uranic oxalate in water containing oxalic acid :—

Bands.	1.	2.	3.	4.	5.	6.
Cold, 24° C. (75° F.)..	97·5	107·8	118·4	127·2	137·2	150·6
Hot, 86° C. (186·8° F.)	97·0	107·4	117·3	125·5	136·0	148·2

The double sulphates also exhibit a like action, as will be seen from the following tables.

Solution of potassio-uranic sulphate :—

Bands.	1.	2.	3.	4.	5.	6.	7.
Cold, 24° C. ..	88·5	96·0	106·4	115·4	124·4	136·5	150·0
Hot, 86° C. ..	—	94·5	104·6	113·8	123·0	133·0	—

Solution of sodio-uranic sulphate :—

Bands.	1.	2.	3.	4.	5.	6.	7.
Cold, 24° C. ..	87·0	96·0	105·8	115·8	125·7	136·8	149·0
Hot, 86° C. ..	—	95·0	105·0	113·8	123·7	135·0	147·0

Solution of ammonio-uranic sulphate in water :—

Bands.	1.	2.	3.	4.	5.	6.	7.
Cold, 24° C. ..	87·6	96·4	105·8	115·8	124·4	136·0	150·6
Hot, 86° C. ..	—	95·2	105·0	114·2	123·4	135·0	147·4

A similar displacement we have also observed in the five absorption-bands of potassium permanganate discovered by Stokes, as the following table will indicate.

Absorption-bands of potassium permanganate dissolved in water :—

Bands.	1.	2.	3.	4.	5.
Cold 24° C. (75° F.) ..	54·7	63·3	72·0	80·6	88·9
Hot, 86° C. (186·8° F.)	53·8	62·4	70·8	79·8	88·0

No displacement could, on the other hand, be detected in the bands of uranous sulphate.

Passing now from these general considerations, we will discuss in detail the various classes of salts examined, beginning with their methods of preparation.

Purification of Material for the Preparation of Salts.

Much difficulty was experienced in procuring the raw material for forming the uranium salts even in a tolerable degree of purity. The uranic nitrate and uranic oxide (so called) found at dealers in rare chemicals always contain considerable quantities of soda, iron, calcium, magnesium, and various other impurities. Some of the pure oxide employed in this research was extracted directly from uranite itself, by a process previously described by one of us,* but this proceeding was abandoned on account of the great amount of time which it consumed.

The commercial uranic nitrate is generally the purest material, but it is the least advantageous, economically speaking, since it commands the same price as the so-called uranic oxide itself.

Uranic nitrate is readily purified by solution in strong ether, the sodic nitrate and other impurities dissolving out in the water of the ether, and forming a layer below the ethereal solution. If the ether be allowed to evaporate spontaneously crystals of uranic nitrate are obtained, but we generally preferred converting this solution directly into uranic oxide, by gently heating until the ether is evaporated and the uranic nitrate is partially decomposed; a higher heat is then applied, and maintained until fumes of nitric tetroxide cease to appear.

Care must be taken to avoid too high a temperature, which would convert the yellow uranic oxide into the green uranoso-uranic oxide: in practice we found the desired temperature is obtained by using a Wetherill burner with the full amount of gas, or a Bunsen burner so placed that the flame cannot come in direct contact with the porcelain dish: in platinum vessels it is more difficult to prevent the formation of the green oxide.

The caked mass of uranic oxide is then removed from the porcelain dish, finely pulverised in an agate mortar (no light task), and again heated until the last traces of nitric tetroxide are removed.

The commercial uranic oxide is invariably either ammonic or sodic uranate, containing also various impurities. The manufacturers of chemicals, who prepare uranium compounds for the trade, are apparently ignorant of the fact that uranic oxide precipitated from its solutions combines with whatever alkali is employed, forming a uranate of the base, or else they knowingly dispose of these uranates as uranic oxide, for reasons satisfactory to themselves. Uranium yellow, so-called, employed by glass and porcelain manufacturers, is prepared directly from the mineral uranite, and consists of sodic uranate; possibly this gets into market as pure uranic oxide.

The pure material which forms the point of departure for the preparation of the salts named in this paper is obtained from the commercial article by the following process:—The impure alkali-uranate is dissolved in hydrochloric acid, the solution is saturated with sulphydric acid, which nearly always produces a small precipitate, filtered, boiled, oxidised with nitric acid, and then poured *into* a quantity of very dilute ammonic hydrate, more than sufficient to neutralise all the acid: by this means the sodic uranate is for the most part converted into ammonic uranate. The precipitate is well washed by decantation (using a syphon) adding a little ammonic chloride to the wash-water when the precipitate refuses to settle, and then transferred, without bringing on a filter, to a porcelain dish. Ammonic carbonate is then added in powder to avoid largely diluting the solution formed, and the whole is digested at a moderate heat until the ammonic uranate is completely dissolved. The solution, filtered while warm from the residue of ferric hydrate, calcium carbonate, &c., deposits, on cooling, beautiful crystals of the double ammonio-uranic carbonate. The mother-liquid from these crystals is vigorously boiled, and deposits a yellow powder, uranic hydrate containing a small percentage of ammonia. This precipitate, however, still retains the alkaline earths and sodium, and the crystals, before obtained, show traces of sodium uranate: these impurities are removed by igniting strongly in a platinum dish, and treating the uranoso-uranic oxide formed with dilute hydrochloric acid, which dissolves out the uranates of the bases RO, while the uranoso-uranic oxide is not attacked. After washing and drying this green oxide, it is dissolved in nitric acid and the solution crystallised; the crystals of uranic nitrate are then dissolved in ether, and treated as above described.

In preparing the various compounds enumerated in the first part of this paper, we generally followed the methods laid down by the authors in their original papers; any detailed account of these methods is therefore superfluous. References to the original papers will be found in the "Index to the Literature of Uranium," prepared by one of us and published in the "Annals of the Lyceum of Natural History (New York), vol. ix., 1870.

A brief summary of some points in the preparation of

* *American Chemist*, vol. i., p. 50, 1870.

the salts will, however, be given in connection with the special discussion of each class.

(To be continued.)

Errata.—Page 47, first column, line 27 from foot, insert "and" between "of" and "while." Second column, line 34 from foot, for "combination" substitute "confirmation." Second column, line 12 from foot, insert "were" between "concentration" and "interchangeably." Second column, line 2 from foot, for "Deraga" substitute "Desaga."

THE CONSTITUTION OF SAFFRANIN.

By SAMUEL E. PHILLIPS.

If in such cases the men of fact and experiment are as yet dependent on speculation, it is surely legitimate to assist such endeavours by all the means at our disposal, the more so if, by placing the matter in another aspect, we can at all add to their powers of practical enquiry, on the old Baconian principle that the secrets of Nature are most freely given up to such as can enquire with humility and intelligence.

We have long regarded the rosanilin dyes as associated with the guanidin type—

Urea	(CO_2) H	H_3N_2
Guanidin ..	H_2 Cy	H_3N_2
Melanilin ..	$(C_{12}H_5)_2Cy$	H_3N_2
Rosanilin ..	$(C_{38}H_{16})Cy$	H_3N_2; $C_{38}H_{16}$ = 2 atoms.
Chrysanilin ..	$(C_{38}H_{14})Cy$	H_3N_2
Anilin blue ..	$(C_{38}H_{16})Cy$	E_3N_2
Leucanilin ..	$(C_{38}H_{18})Cy$	H_3N_2
Opal blue ..	$(C_{38}H_{15})CyPhH_2N_2$	

Both practical and theoretical considerations strongly enforce the idea of a condensation of atoms herein. If, instead of anilin and toluidin, the same conditions were applied to phenol and toluol, the result would certainly be a condensation, thus—

$$\text{Phenol} + \text{toluol} - 2HO = \frac{C_{12}H_4}{C_{14}H_7} = (C_{26}H_{11})O + HO;$$

but, as variations take place by addition or subtraction of 2H, I have preferred to consider the whole group as equivalent to 2 atoms, however arranged or modified.

Chrysanilin, with 3Me replacing 3H, gives a beautiful deep orange-yellow as the iodhydrate, and rosanilin varieties have been formed, with similar aldehyd substitutions, with the radicals of almond oil ($C_{14}H_5$), enanthol ($C_{14}H_{13}$), valerol ($C_{10}H_9$), &c.

Melanilin is produced by the action of cyanogen upon anilin, and when rosanilin is heated with "cyanogen, it loses colour, and deposits a new base with 4N which is regarded as leucanilin in which 1H is replaced by Cy." This is called hydro-cyan rosanilin, and this we now moot as the type of saffranin and mauvin.

The production of saffranin from azo-diamines is another illustration of the condensing conditions we have referred to—

Hydro-cyan rosanilin ..	$(C_{38}H_{18})Cy_2H_2N_2$
Saffranin	$(C_{38}H_{18})Cy_2H_2N_2$
Mauvin	$(C_{38}H_{18})Cy_2PhH N_2$

Are these (3 atoms in 2) varied in this case isomerically, or is the beautiful orange-yellow cyan-rosanilin iodhydrate identical (in its base) with the deep red-yellow saffranin chlorhydrate?

The cyano-production of all these bodies is feasible beyond measure synthetically; and may we look for some new efforts to realise this point analytically?

Whatever be the result, one thing is quite clear, viz., that all these bodies are defiant of the Hofmann law of ammonia combinations. Whether diamines as I view them, triamines, or tetramines, they obey a simpler wider law, and combine with acids, atom for atom—

The free base ..	$(C_{38}H_{18})Cy_2H_2N_2$
Chlorhydrate ..	$(C_{38}H_{18})Cy_2H_3N_2,Cl+HCl$
Chloroplatinate ..	$(C_{38}H_{18})Cy_2H_3N_2,Cl+PtCl_2$
Nitrate	$(C_{38}H_{18})Cy_2H_3N_2,O+NO_5$

Hofmann further refers to the sulphate, oxalate, &c., all of which doubtless similarly conform.

Magdala is another red dye which may possibly belong to the same character of type, constitution, and general properties. Some years ago, Perkin and Church obtained "a beautiful crystalline compound, consisting of 2 atoms of naphthylamin linked together by an atom of trivalent N—

$$\left.\begin{matrix}(C_{10}H_7)_2\\ H\\ N'''\end{matrix}\right\}N_2,"$$

and subsequently M. Clavel, of Basle, patented a process for a beautiful crimson dye "heating together equal quantities of isomeric naphthylamin, acetic acid, and nitrite of potassium." This can now be obtained from ordinary naphthylamin and "an acid, by a process similar to that of rosanilin from anilin, and we thus get magdala—

$$\left.\begin{matrix}(C_{10}H_7)_3\\ N'''\end{matrix}\right\}N_2,$$

and, in boiling the first with anilin, we evidently get—

$$\left.\begin{matrix}(C_{10}H_7)_2\\ (C_{12}H_5)\\ N'''\end{matrix}\right\}N_2,$$

another red colouring matter."

Rosanilin	$(C_{26}H_{11})(C_{12}H_5)CyH_3N_2$
Perkin and Church	$(C_{20}H_7)(C_{18}H_5)CyH_3N_2$
Magdala	$(C_{40}H_{13})(C_{18}H_5)CyH_3N_2$
Red colouring matter ..	$(C_{40}H_{13})(C_{12}H_5)CyH_3N_2$

In the last two I have, for reasons before mentioned, assumed the naphthyl element as a dinaphthyl, which is not a mere hypothetical body; but, if preferred, it may be regarded as $(C_{20}H_7)_2(C_{18}H_5)CyH_2N_2$. Against this latter view I would urge that, as we have an ethyl-mauvin, so we might have ethyl, methyl, or aldehyd replacements of both saffranin and magdala, and these might show whether we have 2 or 3 atoms of H available for these replacements.

Having felt some interest in writing this short notice ofihand, I laid it down with a strong feeling of dissatisfaction, in that it fell so far short of what seemed to be desiderated in regard to the condensing conditions implied in the multifarious production of azodiamine, nitrile, and other bases. The refined labours of Griess, Hofmann, and others, have produced a very wide harvest of facts, and some great effort is needed in the direction of a simple and comprehensive classification.

This new and fertile character of reaction comes in contact at several points with anilin, or rather coal-tar, production; at another moment we are penetrating the indigo or kreatinin series; while, at another point, we are immersed in caffein or uramin derivatives; and it is almost beyond question that, in the whole of these, a certain amount of carbon is condensed into the cyanogen atom. But the cyano aspect is only one feature of the reaction, and the other, most relied upon in our estimate of saffranin, meets with a striking confirmation in another memoir from that fertile pen which has laid us under such deep obligation. We may cavil at certain points of hypothesis or type-representation; but for a commanding genius, for one who penetrates so successfully into unknown regions, there can be only one award of universal

esteem and admiration. We therefore continue the subject by a brief abstract of M. Hofmann's paper (CHEMICAL NEWS, vol. xxvii., p. 1), "On the Synthesis of Aromatic Ammonias by Atomic Interchange." He found that the action of methylic alcohol on anilin, at high temperature and pressure, is far from producing methyl- and dimethyl-anilin exclusively, as hitherto believed, and that the substitution takes place in the phenyl radical, thus producing quite a series of higher homologues. He thinks the replacement of the Me takes place first in the fourth atom of H "in the chlorhydric acid of the anilin salt," then in the others, and finally in the phenyl radical itself, but moots it as strange that, when a tertiary monamine is submitted to the action of an alcoholic chloride, a quartary ammonium is invariably found; and yet, in the above process, only tertiary, and never any quartary, bases are observed.

In the praiseworthy "endeavour to gain an insight into the mechanism of this reaction," M. Hofmann assumes what is perhaps unnecessary, and strangely overlooks the patent facts of the condensing conditions, and the evolution of H in the substitutional condensation of the phenyl radical. The phenyl element ($C_{12}H_5$) becomes—

$$C_{12}H_5 + C_2H_3 - 1H = C_{14}H_7,$$
$$\text{or } C_{12}H_5 + 2Me - 2H = (C_{16}H_9),$$
$$\text{or } C_{12}H_5 + 3Me - 3H = C_{18}H_{11}.$$

Ordinary action .. .. .. $(C_{12}H_5)Me_2N + MeCl = (C_{12}H_5)Me_3N,Cl$

Do. with heat and pressure .. $(C_{12}H_5)Me_2N + MeCl = (C_{14}H_7)Me_2HN,Cl$

His illustration of the real facts of the case is plain beyond measure:—"Accordingly, trimethylated ammonium iodide, submitted to the action of heat and pressure, is transformed into—

(1) Dimethyl-toluidin iodhydrate .. $(C_{14}H_7)Me_2H\ N,I$
(2) Methyl-xylidin iodhydrate .. $(C_{16}H_9)Me\ H_2N,I$
(2) Cumidin iodhydrate .. .. .. $(C_{18}H_{11})\ H_3N,I$"

Here, then, is one of the first formal demonstrations of the action we have mooted as the secret or chief feature in the production of rosanilin or saffranin varieties, and guided by a parallel study of the same influence, we confidently predict the imminent artificial production of thein or caffein, of which more anon.

CARBOLIC ACID AND ITS RELATION TO CREASOTE.*

By A. M. READ.

CARBOLIC acid was discovered in the year 1834, by Runge, who found it to be a constituent of coal-tar oil. Its chemical properties were more thoroughly investigated in the year 1841, by Laurent, who made it from the lighter oils of coal-tar, and who considered it to be an hydrated oxide of a peculiar compound radical, which he called phenyl, and described it under the name of hydrate of phenyl. It has been variously named by different writers, phenic acid, phenyl alcohol, hydrate of phenyl, coal-tar creasote, carbolic acid, and phenol, the latter of which is the name under which it is generally treated of in text-books, although carbolic acid is and probably ever will be its common name.

Carbolic acid is produced by the action of nitrous acid on anilin, and by the dry distillation of gum benzoin, quinic acid, chromate of pelosina, salicylic acid, coal, and the resin of *Zanthorrhœa hastilis*. It is found in the urine of the horse, cow, and man, and in castor. It is also reported as having been obtained from a plant growing on the high lands of India (the *Andromeda Leschenaultii*), which is said to yield† a very pure quality, less deliquescent than that made from coal-tar oil, but at a much greater cost. It forms the chief constituent of the acid portion of coal-tar oil, from which it is generally obtained by the process given below.

The coal-tar oil is subject to distillation in a retort furnished with a thermometer, and the portion that passes over between the temperature of 150° and 200° C. (302° and 390° F.), is collected apart. This product is then mixed with a hot strong solution of caustic potash and left to stand, whereby a whitish, somewhat crystalline pasty mass is obtained, which, by the action of water, is resolved into a light oily liquid and a dense alkaline solution. The latter is withdrawn by a syphon, decomposed by hydrochloric acid, and the separated oil purified by contact with calcium chloride, and re-distillation. It is then exposed to a low temperature, and the crystals formed are drained from the mother-liquor and carefully preserved from the air.

Pure carbolic acid forms long colourless prismatic crystals, which melt at 35° C. (95° F.), to an oily liquid, boiling at 180° C. (356° F.), and greatly resembling creasote in many particulars. It is soluble in about 14 parts of water, freely soluble in alcohol, glycerin, ether, and strong acetic acid, and gives no acid reaction to test-paper. It is very deliquescent, absorbing moisture from the atmosphere with avidity and liquefying. It coagulates albumen readily, and is therefore a powerful antiseptic. Sulphur and iodine dissolve in it. Nitric acid, bromine, and chlorine attack it with energy, forming substitution products, all of which are of an acid character. It also forms substitution products with sulphuric acid, and is dissolved by alkalies, forming salts called phenates. It reduces mercuric oxide at the boiling point; separates silver from the nitrate; reduces the peroxide of lead to the protoxide; and upon heating it with arsenic acid forms a yellow substance called xanthophenic acid. One of the most common impurities found in carbolic acid is coal-tar oil. This can easily be detected by mixing the suspected acid with about 20 parts of water, when the acid will be dissolved, leaving the insoluble oil floating on the surface. Pure carbolic acid gives a pure blue colour to pine wood previously treated with hydrochloric acid; a green colour indicates aniline, and a brown pyrrhol. It ought not to turn brown in the air, even in the presence of ammonia; and should give, with sulphate of iron, not a red but a pure lilac colour. When immersed in an aqueous solution of chromic acid it is immediately turned black.

There have been a great many tests given to distinguish creasote from carbolic acid; but none of them have proved satisfactory. I give below some of the principal ones now used for that purpose.

With three or four volumes of a saturated aqueous solution of baryta, carbolic acid forms a clear solution, which, after standing, gives no deposit, or only a slight pulverulent one, while with creasote it forms an incomplete cloudy solution.

With an alcoholic solution of chloride of iron, creasote gives a green colour, carbolic acid a brown; but with an aqueous solution of the same, creasote gives no reaction, while carbolic acid gives a blue colour.

According to Mr. Morson, pure creasote is insoluble in glycerin, while carbonic acid forms with it a perfectly clear solution. As this test has been the subject of some controversy which has attracted considerable attention, I have made a few experiments with it, the results of which I give below.

I first tried the common creasote of commerce with an equal volume of glycerin, and found it to be readily soluble; Merck's gave the same result, but Morson's refused to dissolve in glycerin, sp. gr. 1·253, even after three or four volumes had been added.

I then carefully added carbolic acid to a mixture of Morson's creasote and glycerin, and found that upon the addition of 23 per cent of Calvert's No. 2 acid the creasot

* Read before the National College of Pharmacy, Washington, D.C.

† From its volatile oil, of the composition of oleum gaultheriæ.—*Ed. Am. Journ. Pharm.*

became soluble, forming a perfectly clear solution with the glycerin.

Upon the addition of water to the three solutions of creasote, they each became cloudy, and the creasote soon separated; while upon a solution of carbolic acid in glycerin, water had no effect whatever.

Some time ago, while preparing a catarrh mixture in which carbolic acid is used in conjunction with liquor ammoniæ fortior, alcohol, and water, I found that upon the addition of the ammonia to the acid, the acid was readily dissolved, forming a clear solution, which did not change upon the addition of the other ingredients; but which, after standing a few hours, became a beautiful violet blue colour. Having been taught by text-books that carbolic acid was insoluble in ammonia, I was somewhat surprised at this result, and upon referring to Watts, Gmelin, and other authorities, and finding that they made the same statement,* my surprise was somewhat intensified. I immediately instituted a series of experiments, and found that carbolic acid was certainly soluble in ammonia, but whether owing to impurities present I could not say. I used Calvert's No. 2 acid, which was immediately dissolved by the ammonia, forming a clear solution, which, upon standing about six hours, gave the violet blue colour spoken of above, the acid still remaining in solution, and giving no precipitate.

I then tried the ammonia upon common creasote, which I found to be insoluble in it, but which, after a short time, acquired a light blue colour.

To carry these experiments to a successful issue, it became necessary to procure chemically pure carbolic acid and creasote. After a number of attempts I succeeded in getting Morson's and Merck's creasote, and having in the meantime found in the *Druggists' Circular* a process for purifying carbolic acid, which, with some modifications, I have used, I have succeeded, I think, in confirming my first experiments.

I will give the process of purification as used by myself.

I put into a pint flask 1 oz. of Calvert's No. 1 acid, crystallised, and gradually added 10 ozs. of distilled water, shaking it frequently, when I found that 6½ drachms of the acid were dissolved, leaving 1½ drachms undissolved to contain the impurities, which are less soluble than the acid. As soon as the solution became clear I carefully poured it off, placed it in a hydrometer glass, and added, with constant agitation, finely powdered salt (previously purified by dissolving it in water, filtering the solution, and evaporating to dryness), until the water was saturated, and the acid arose to the top. I then carefully removed the acid with a pipette. Upon the addition of ammonia to this product it was very readily dissolved; but it did not give the violet-blue colour until after standing about twelve hours. Not being satisfied, I re-purified it in the same way, being careful not to add as much water as I did at first.

The addition of an equal volume of ammonia to this product of re-purification quickly dissolved it, forming a perfectly clear solution, which did not acquire the violet-blue colour until standing nearly thirty hours.

For want of time I was not able to carry the purification by fractional distillation as I should like to have done; still I consider the product of re-purification very nearly pure—much purer, at least, than any I could find in the market.

Upon the addition of ammonia to this acid, as stated above, it was readily dissolved; while, upon Morson's creasote, ammonia had no effect whatever, neither dissolving it nor giving it the blue colour that it gave to the common creasote. Merck's creasote gave the same result; it as well as other samples that I have tried being perfectly insoluble in ammonia.

The ammonia used in the experiments given above was the aqua ammoniæ fortior of the U. S. P., sp. gr. 0·900. The aqua ammoniæ U. S. P., sp. gr. 0·960, would answer the same purpose, but a much larger proportion would be required.

After the successful termination of the experiments given above, I have no hesitation in suggesting aqua ammoniæ fortior as a test to distinguish between carbolic acid and creasote; and of leaving its value as compared to other tests now known to the judgment of the pharmacist and chemist.

* *Note by the Editor of Am. Journ. Pharm.*—Gmelin's "Handbook," edition of Cavendish Society, vol. xi., p. 150, contains the following:—

Carbolate of Ammonia.—Carbolic acid absorbs ammoniacal gas abundantly and with evolution of heat, forming carbolate of ammonia (Laurent, Hofmann, *Ann. Pharm.*, 47, 75). This salt, passed in the state of vapour through a glass tube at a low red heat, deposits a small quantity of charcoal, but does not form any aniline; which, however, is formed at 300° C. in sealed tubes, and sparingly when an alcoholic solution of carbolate of ammonia is set aside for a month (Laurent). Strong ammonia dissolves quickly in coal creasote, and the mixture turns red when exposed to the air (Reichenbach). The salt obtained with carbolic acid remains colourless, and even when it contains but little ammonia, exhibits alkaline reaction, exhales ammonia, and volatilises (Runge). Creasote dissolves in ammonia, even in the cold; and the solution gives off all its ammonia at 100° (Gorup-Besanez

IRON ELECTROTYPES.

The art of electrotyping, already applied to myriad uses, shows constant evidence of progress, especially in the successful deposition for practical purposes of metals that have hitherto been considered intractable. Nickel plating is now common, and, while cheaper, is for some purposes superior to silver; and there is some reason to suppose that by the employment of a small percentage of some other metal to diminish the brittleness, the rather refractory nature of the nickel coating may be brought more completely under the control of the burnisher in lieu of the polishing wheel, than is now the case. There are many purposes, however, for which a plating of iron would be, all things considered, better than any of those now familiar in electro-metallurgy, and to secure this has occupied the attention of some foreign experimenters, who have apparently been very successful in their efforts. These are described in a lengthy article in a number of *Engineering*, from which we take the following:—

"At the late London International Exhibition (1871) were exhibited bank-note plates, medallions, and a page of printing-type, electrotyped in iron by a process devised by M. Eugene Klein, who is at the head of the Chemical Department in the Imperial State Paper Manufactory in St. Petersburg. From a paper upon the subject, read by Professor Jacobi before the Academy of Sciences in Russia, in 1868, it appears that in the previous year M. Feuquières sent to the Paris Exhibition some specimens of iron electrotype which presented a fair appearance as regarded surface, but still were inferior to those produced by M. Klein in the year following. M. Klein saw M. Feuquières's specimens at the Paris Exhibition, and on his return to St. Petersburg, in October, 1867, renewed his previous attempts to electrotype in iron. The scientific interest which attached to the new development, and the eminently useful applications of which he saw it was susceptible, especially in the departments of engraving and printing, stimulated M. Klein, and in the early part of 1868 he had accomplished his object. The medals produced in the early part of M. Klein's researches showed on their reverse porosities and deep hollows, which penetrated nearly through the thickness of the deposit. These cavities were also observable in great numbers in the productions of M. Feuquières. In M. Klein's later specimens these singular cavities—which probably proceeded from bubbles of gas—entirely disappeared, and their reverses are in no way inferior to those of copper specimens produced under the best conditions. The starting-point of M. Klein was the steeling of engraved copper-plates, which process was effected in a bath composed of the chlorate of ammonia and iron, to which he added a small

portion of glycerin. Those, however, who have paid attention to the steeling process have had occasion to remark that in giving the deposit of iron a greater thickness, the surface cracked, and the deposit detached itself from the cathode in excessively brittle flakes. It became necessary, therefore, to employ baths of two different classes, composed of sulphate of iron and sulphate or chlorate of ammonia. Finally, M. Klein devised three baths after the formulæ FeO,SO_3+NH_4O,SO_3+6HO.

"The first bath consists of a concentrated solution of crystals of the double salt FeO,SO_3+NH_4O,SO_3+6HO above mentioned. The second bath was composed by mixing the concentrated solution of each of these two salts in the proportions of their equivalents. At length M. Klein obtained the third bath by taking a solution of sulphate of iron, precipitating the iron by carbonate of ammonia, and dissolving the precipitate by sulphuric acid, getting rid of all excess of acid. In preparing the baths of the second class, M. Klein, as we have stated, mixed the solutions of chlorate of ammonia and sulphate of iron in the proportions of their equivalents. Another method employed is to dissolve, in a solution of sulphate of iron, as much chlorate of ammonia as it will readily absorb at a temperature of about 66° F. All these baths were concentrated as highly as they could be. As an anode, M. Klein employed iron plates giving a surface of about eight times that of the copper cathode. In using a Daniell battery for the decomposition, the deposit was formed in twenty-four hours upon the whole of the cathode. The deposit, however, was full of flaws, and was easily detached and broken up into fragments. As it often happens that the solution of sulphate of copper improves by use, M. Klein hoped that the iron solutions would act in a similar manner. He therefore continued the experiments for several days, without, however, obtaining any better results. Under the advice of Professor Jacobi, instead of a pair of Daniell cells for each of the five stages of decomposition, he then employed four pairs of feebler Meidinger cells, uniting them in series with the five stages of decomposition. This arrangement was found to give a smaller development of hydrogen at the cathodes, and better final results. The deposits, however, were not yet perfect, some exhibiting porosity, and others being furrowed.

"Conceiving from previous experience that this was due to acidification of the bath, M. Klein tested it, and found a very decided acid reaction. He attributed this acidification to the circumstance that the quantity of iron deposited on the cathode was greater than that dissolved by the anode. It was, therefore, necessary to give the anode a greater degree of solubility, and as that could only be affected by increasing its area, M. Klein conceived the idea of placing in the bath a plate of copper, and uniting it with the iron. The result of this combination was very remarkable; not only were the baths of the first class rendered neutral after several hours, but the deposits became much more uniform. Their colour was a dull grey; they adhered perfectly to the cathode without warping or cracking any part. During the first twenty-four hours the surfaces remained perfectly even, but afterwards they began to exhibit minute cavities similar to the appearances often produced upon galvanic deposits of copper. These cavities, however, rarely penetrate to the depth of the deposit. Their production is attributed to the superabundant disengagement of gas on the surface of the cathode. It probably happens that these bubbles attach themselves strongly enough to hinder the formation of the deposit. If the energy of the current becomes too great, these annoying phenomena are produced more frequently. By reducing this energy in the process, and having only an imperceptible disengagement of gas, by diminishing the concentration of the bath, or augmenting the resistance of the solid portions of the circuit, the formation of these cavities entirely disappeared, and the beautiful results to which we have already referred have been obtained. A microscopical examination of the reverses of the deposits produced by M. Klein's final process fails to discover any porosity or irregularity in the specimens. On leaving the bath, the iron is as hard as tempered steel, and very brittle. Re-heated to a dull red heat, it loses much of its sharpness and hardness. Heated to a cherry-red, it becomes malleable, and may be engraved as easily as soft steel. If the deposits are produced in good condition, and annealed uniformly and with the necessary precautions, they are subject to neither warp nor bend. There is no contraction, but, on the contrary, a slight degree of expansion, almost imperceptible, however. Owing to the necessity of having bank-note and similar plates identical in every respect, it is of the first importance that they should not be distorted, nor have their dimensions altered in the process of annealing. It appears that the galvanic deposit of iron has not only permanent magnetism, but that, like soft iron, it receives the magnetism of position. Of the importance of the practical application of the process there can be no doubt whatever. By replacing plates of copper by those of iron, greater facilities will be afforded for producing publications, works of art, and especially bank-notes and cheques. Iron electrotype plates are found to be almost indestructible. They not only can be printed from an almost unlimited number of times, but they are better calculated than those of copper to withstand those inevitable accidents constantly occurring in printing establishments. Printers are sometimes obliged to set aside as useless their best plates, which are often damaged by a grain of sand or by a chance knot in the paper. These accidents not only involve the expense of renewing the plates, but sometimes occasion interruptions and delays in works of a very pressing nature. These are some amongst the many advantages which may be expected to accrue from the introduction of iron electrotypes."

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 106.)

Now, to examine these muscles—their fibres and their fibrillæ, to watch their action, and to speculate upon the causes of this action, is a department of science full of interest, and from which much that is valuable may be brought. The object of this lecture does not require that any such investigation should be made, and the competency of the lecturer is not equal to the task. Dr. Haughton, of Trinity College, Dublin, has for many years sought for means and opportunities, and availed himself of them, even at the risk of his own life, for determining accurate measurements of muscular force. This first mention of the name of one who for twelve or fourteen years has given that attention to this subject which enthusiasm alone could induce, must not be passed without this addition. In reply to a letter towards the close of 1872, Dr. Haughton most kindly sent me 400 pages of the proof sheets of a work on "Animal Mechanics," which has not yet been published.† This work is my authority for the figures relating to the experiments in respect to muscular strength and endurance. With the results his careful and numerous opportunities have afforded him we are clearly concerned. How carefully these have been

* The Cantor Lectures, delivered before the Society of Arts.

† Since the delivery of this lecture the work has been published, under the title of "The Principles of Animal Mechanics," by the Rev. Samuel Haughton, F.R.S., Fellow of Trinity College, Dublin. London: Longmans, Green, and Co. Dr. Haughton states in the preface that "the work is offered to the public with the view of showing the mutual advantage obtainable by anatomists and geometers from a combination of the sciences they cultivate. Anatomists will gain by the increased precision which numerical statements must give to their observations, and geometers will find in anatomy a new field of problems opened out to their investigations."

collected may be judged from the following. He writes, "This much I can guarantee, all the dissections, weighings, and observations have been made by my own hands, with every precaution of which I could think to ensure accuracy. My observations have also been made without preconceived hypothesis to guide them; and many of my most interesting results have been forced upon my notice by the facts placed before my eyes in the dissecting room and laboratory."

First, as to the expression "coefficient of muscular force." On the wall is a table of "coefficients of muscular force."

In the arm	94·7 lbs.	per square inch.
„ leg	110·4 lbs.	„ „
„ abdomen	107·0 lbs.	„ „
Average	104·0	

The term "coefficient" is a word of common occurrence in scientific investigation, and is plainly obtainable from "coefficiency." When we speak of coefficiency we mean "that two or more things combine to produce an effect." It is the figure by which a unit measurement is multiplied in order to produce a result. To find the coefficient of muscular force is to find some quantity which may be so combined with a measured area of muscle as that we can have a result on which to rely in reference to the question proposed. Adopting the view which the lectures on energy and gravity propounded, it may suffice for the present to say that the table on the wall tells us that, knowing the number of square inches contained in the cross section of any muscle, then multiplying these by the figures there stated, we obtain the weight which the particular muscle can, on sudden emergencies or for a very short space of time, sustain. It is the limit of endurance—it is the measure of lead which is just sufficient to cause the muscle to break—if a small weight more be added then the muscular fibres will be broken. It is the very extreme tension to which muscular fibre may be subjected without actual rupture. It is obtained by treating muscle as engineers treat wrought-iron rods when they seek to ascertain what load they can carry by tension. This explains that the table does not give a coefficient of work the muscles can do; such a coefficient depends upon the energy that vitality (or vital force, if the term be preferred) can infuse into the muscle; but, however great that vital power may be, the work done by the muscle must be less than that obtained in the table to which these remarks apply. A few words in illustration may not be misplaced.

We find from experiments, which would occupy far more than an hour to narrate, that in order really to tear 1 square inch of muscle across, it would require 94·7 lbs. in the arm, and in the leg 110·4 lbs. It is somewhat remarkable that in the arm, which does not carry the body, you have 94 as the strength of the muscle. When you come to those connected with the leg, which have to carry the body as well as do work, the fibres are very much stronger. Taking the average of the whole body, the coefficient of 1 square inch of muscle in the human frame is 104. Therefore if we know the size of any particular muscle and multiply it by 104, we get in lbs. weight the limit of strain it will endure before fracture.

Now the next question is, how much it will raise. In this view of the case motion enters. Supposing a fibre was in the form of a string, a very long one, and by contracting it will raise 2 lbs. weight through 10 feet. If, now, that fibre were doubled and only half the length, it would raise 4 lbs., but it would only lift it through half the space, because its power of contraction would be diminished by the doubling. Now, the products of the weight raised, and the distance through which it is raised, are the same in both cases. If it raises 2 lbs. through 20 feet, 40 would be the measure of that muscular exertion; and if it raised 20 lbs. through 2 feet, 40 would still be the measure; but the distances are different. After illustrating experimentally these statements, the lecturer remarked that if an ounce of muscle be distributed with large sectional area, then its contraction will be little, but the weight raised may be great.

Muscle has also another peculiarity different from anything with which we can deal. If a bundle of it be taken, as you are aware, it acts by contraction; but while it contracts it does not change its bulk. It does not swell out as we understand the word—it merely contracts. Thus, if you had a long muscle acting in a vessel of water, and it contracted ever so powerfully, it would not in the slightest degree affect the level of the water in the vessel.

Now we come to the mode in which the mechanical action of these combined muscular fibres is to be brought to a question of simple calculation. As far back as 1798 Dr. Wollaston occasionally observed a peculiar sound in his ears, for which he could not account. He pondered over this sound until about 1808, when a faint dawn began to enlighten the gloom. In 1809 he made clear to his friends what he was about, and in 1810 the results were published in the *Philosophical Transactions*. What he then did is the basis of all our present knowledge of this subject of muscular power.

Dr. Wollaston began to surmise that the sound in his ears arose from muscular contractions. He stated that he was led to infer the existence of intermittent contractions, from a sensation perceptible upon inserting the extremity of a finger in the ear. A sound is then perceived which resembles most nearly that of carriages at a great distance passing rapidly over the pavement. The sound is not dependent upon the degree of pressure upon the tympanum, for when the ear is stopped with great force without the presence of muscular action no such sound is produced. For instance, if the head press with its whole weight upon the ball of the thumb no noise is perceived unless the extremity of the thumb be at the same time pressed against the head, or some other muscle be brought into play. To judge of the frequency of this contractile action, he contrived to imitate the sound and to render the sound itself and the imitation audible by the same ear. It was accomplished thus. While the ear rested on the ball of the thumb the elbow was supported by a board lying horizontally, in which were cut notches about $\frac{1}{8}$ inch asunder similar to those in this board. By rubbing a pencil along these notches with a regular motion he imitated pretty correctly the tremor produced, and by counting the marks and noting the time, he found repeated observations agree with each other as nearly as could be expected. He also varied the experiment. One variety was this—the ear was stopped by a cushion pressed upon by the end of a notched stick that rested on his foot and conveyed the vibrations from the muscles of the leg to the ear along with the tremor produced by friction upon the notches; and still the results were nearly the same, viz., that the muscular vibrations resembled the sound of carriages at a distance. He induced many friends to repeat the experiments, and by going through the form of the experiment any one may, when convenient, satisfy himself. The humming sound will, of course, be perceptible only to the ears of the experimenter.

Put the first finger of each hand to the ears, not pressing them tightly, resting the elbows on a table thus, and then clench the fists firmly, you will immediately throw the muscles of the arm into action, and as soon as they are brought into action there is a peculiar humming sound perceptible. That is a sound caused much as the sound of flies, when buzzing about, is caused, or as humming birds cause their sound; it is caused by an intermittent action; in this case of the muscles, and upon that action, the rest of this lecture will turn. There is, however, a better plan even than that for observing this phenomenon. When you go to bed, if you are particularly bent on scientific research, and will lay your head on the pillow so as to entirely exclude all external sounds from the ear, then clench the teeth firmly, those muscles which are concerned in masticating the food are brought into play, and you hear the sound most distinctly. Now, that

sound gives a musical note, and from that musical note all our knowledge of muscular action springs. All musical notes are caused by the frequent repetition of a vibration at equal intervals. Here is a glass tube of some length, and a little jet of gas lighted. If the tube be placed over the gas-light you hear a musical note. That is caused by the light being extinguished and re-lighted a certain number of times per minute, as you can see by watching the reflection in the mirror. If, now, the mirror be shaken behind the light, a number of separate flames appear, if these are counted we can ascertain how often they occur in a minute or an hour. Therefore we know the number of beats which produce that musical note. Here is an instrument for causing a sound by the frequent interruption, at equal intervals of time, of a stream of air. The number of interruptions in a given time are recorded by the wheel-work and indicated on these dials. It is called a "Siren." Again, here is a gyroscope, which does the same thing. If some string be wound round, and it is set in rapid rotation, and then a piece of cane or quill be pressed against the little wheel at one end of the axle, the note produced will vary according to the speed of the rotation. Another illustration may be had from the heating of metals of certain peculiar-shaped surfaces, and laying them on cold metal,—sometimes a peculiar humming sound is heard.

When Dr. Haughton was suffering from a singing in the ears after an attack of fever, he produced a sound by exercising the muscles of the jaws; this sound was in unison with the singing in the ears, but separated from it by several octaves. Dr. Haughton was struck, like Dr. Wollaston, with the resemblance of the sound to distant cabs. He measured the intervals of the granite pavement, and found them about 4 inches apart. This gave three impulses in the foot. If the cabs were driven at 8 miles per hour we have 35·2 impulses per second. An organ-pipe with a movable stop was tuned in unison, and thus 35 1-3 vibrations per second were deduced.

From this rate of muscular contraction Dr. Haughton deduces the amount of work stored up in human muscles. It may facilitate an explanation of the table and diagrams on the wall if, in as simple and clear a manner as in my power, the mode of conducting the experiments is described. Remember the object is to make clear to all not only the mode, but also the principles on which these experiments rest. Therefore every technical or professional term must, as far as possible, be avoided.

(To be continued).

MISCELLANEOUS.

University of London—First B.Sc. and Preliminary Scientific M.B. Examinations.—The following are lists of candidates who have passed the recent Examinations for Honours:—*Mathematics and Mechanical Philosophy* (First B.A. and First B.Sc. conjointly).—First Class. M. J. M. Hill, First B.A. (Exhibition), University College. Third Class. J. Edwards, First B.A., Owens College, and W. Fawcett, First B.A., private study (equal). *Chemistry* (First B.Sc. and Preliminary M.B. conjointly).—First Class. C. M. Thompson, First B.Sc. (Exhibition), University College; J. V. Jones, First B.Sc., University College; G. Christopher, First B.Sc., University College; P. P. Bedson, First B.Sc. and Prel. Sci., Owens College. Second Class. D. R. Jones, Prel. Sci., University College; S. A. Hill, First B.Sc. and Prel. Sci., Royal School of Mines; H. Davy, Prel. Sci., Guy's Hospital; H. Robson, First B.Sc. and Prel. Sci., University College. Third Class. W. Banks, Prel. Sci., private study; A. Daniel, Prel. Sci., University of Edinburgh, and J. W. Meek, Prel. Sci., Owens College (equal); C. Hopkinson, First B.Sc., Owens College, and O. J. Lodge, First B.Sc. and Prel. Sci., private study, and J. Ryley, Prel. Sci., University College (equal); W. P. Mears, Prel. Sci., London Hospital; T. F. Harris, First B.Sc., private study. *Experimental Physics.*—First Class. O. J. Lodge, First B.Sc. and Prel. Sci., private study. Second Class. H. Sainsbury, Prel. Sci., University College. Third Class. D. R. Jones, Prel. Sci., University College; J. V. Jones, First B.Sc., University College. *Organic Chemistry, and Materia Medica and Pharmaceutical Chemistry* (First M.B.).—First Class. A. H. Jones (Exhibition and Gold Medal), Guy's Hospital; A. J. Pepper (Gold Medal), University College. Second Class. T. K. Rogers, University College; C. L. Jones, Guy's Hospital, and E. W. White, King's College.

CORRESPONDENCE.

THE NESSLER REACTION.

To the Editor of the Chemical News.

Sir,—The Nessler reaction appears very unmanageable in some hands; you will therefore probably admit the value of the following simple suggestion:—In diluting the stock standard sulphate of ammonia solution, and also in making the Nessler comparisons, use, instead of pure distilled water, distilled water which has been recently boiled after the addition of some caustic potash.

This is a ready means of getting water free from ammonia, and considerably heightens the sharpness of the comparison texts. I have adopted the plan some years.—I am, &c.,

Sidney W. Rich.

Laboratory, 1A, Chenies Street, W.C.

NOTES AND QUERIES.

Anthracen.—In experimenting with this substance I endeavoured to prepare the pure material by sublimation from the residue left on digesting crude anthracen in alcohol (sp. gr. 825), which residue contains 90 to 100 per cent pure anthracen. In this way I obtained a product, yellowish-white and snow-like, being exactly like the anthracen which crystallises from benzol (90 per cent), but on testing its melting-point, I found it to be below 180° C., instead of 210° C., the melting-point of pure anthracen, according to most authors. What explanation to give for this I really do not know, unless it is that the product is a mixture of anthracen and naphthalin, but the latter body should have been completely washed out, 400 c.c. of alcohol having been used in washing only 20 grms. of the crude pressed anthracen, and of this, after washing and drying, only 6·8 grms. of insoluble matter remained. At the same time I obtained, as I have repeatedly n other experiments, a most beautiful cluster of thin, iridescent, transparent plates: these I have often found attached to the under surface of the filter-paper on which I have been drying anthracen. I shall be glad, if any other readers of your valuable paper have made similar experiments, if they will forward their results and inferences. On a future occasion I shall have great pleasure in sending an account of any other experiments I have made on anthracen which will be more worthy of publication than this short account may be.—T. H. D.

Notes on the Utilisation of Sewage.—

97. (To Mr. Bazalgette). What is the total amount in tons of the sewage of the northern side of the Metropolis?—The sewage on the north side is altogether 87,000,000 gallons per diem.

98. (To the same). How much would be in a year?—It is probably worked out pretty correct in page 106 of this report of the Main Drainage Committee, where it is stated the annual volume of the sewage on the north side amounts to 36,967,285,300 of gallons.

99. How many tons would that be in the year?—168,033,115 tons.

104. (To Mr. Thwaites.) The greater part of those 168,033,115 tons of sewage would be discharged on the 20,000 acres of sands, would they not?—I believe they did intend to discharge there.

107. If they did you would allow, would you not, that it would be nearly seven feet deep if it were all collected there at once?—No doubt.

223. (To Mr. Thwaites). Are you aware that Messrs. Hofmann and Witt have stated that the liquid contains six-sevenths of the sewage in solution, and that there is only one-seventh in the mud?—I believe that that is so.

356. (To the same). Are you aware that Messrs. Hofmann and Witt have stated, and that those who made this report have corroborated them in that statement, that 1250 tons of liquid sewage are equal in value to one ton of guano?—Yes.

380. (To Mr. Bazalgette). When would you put the sewage over the land between the Abbey Mills and the Maplin sands, during the whole of the year?—I can hardly conceive that the sewage would be applicable to the land during the whole of the year.

381. (To the same). What would you do with it at those times at which it was not applicable to the land?—I should take it into the present outfall.

509. (To Mr. Hemans). I suppose you are aware that in eight hours out of the 24 the half of the sewage flows?—I am aware that there is a larger proportion at one period of the 24 hours than there is at another.

512. (To the same). Then if the half of it flows in eight hours, that would be 250 cubic feet per acre in eight hours?—Supposing the half to come in eight hours it would be 250 cubic feet.

513. (To Mr. Hope). What would be the thickness of this per acre per annum?—It comes to seven feet per acre per annum.

514. (To Mr. Hemans). Do you confirm that? On 10,000 acres only it would be seven feet thick, but on 20,000 acres it is four feet per acre per annum.

757. (To Mr. Hope). You have stated that the Edinburgh experiments were a great success?—Yes.

758. (To the same). To whom have these experiments been a great success?—To the proprietors.

759. (To the same), They have not been a great success to the ratepayers?—Certainly not; they get no benefit whatever from the arrangement.

782. (To the same). But with regard to the value of the sewage to the town of Edinburgh, do they receive anything for it?—Nothing; the sewage flows into a natural stream, which happens to pass through this farm; and passing through the farm they have gradually adopted it for irrigation, and extended the system, as they found it paid better than ordinary cultivation.

783. (To the same). How many tons of sewage do you propose to distribute on the Maplin Sands?—If the whole of the sewage is placed there, it would be about 8000 tons per acre per annum.

825. (To Mr. Hope). It has been stated that the value of the sewage has been computed at 6s. per head of the population; upon what estimate is that calculation based?—I believe that that is based upon a very long series of experiments by a number of different chemists, but that is only the theoretical value.

826. Has that any reference to the expense of carrying the sewage from the place at which it is thrown into the river to the place of its application?—None whatever.

(Report of the Main Drainage Committee for 1864, vol. 487).

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of white-lead, and in the purification of carbonic acid gas used in the said manufacture, and in apparatus therefor. George Haseltine, Southampton Buildings, London. (A communication from Asa P. Meylert, New Britain, Connecticut, U.S.A.). January 18, 1873.—No. 213. My invention relates to an improved apparatus for manufacturing white-lead, and also to improved methods of purifying the carbonic acid gas used in the said manufacture. I use an apparatus whereby the carbonic acid gas required for corroding the lead is used to assist in conveying the vapour of acetic acid into contact with the metallic lead, and is also used to assist in vapourising the acetic acid required for corrosion. The method of manufacturing white-lead by the said apparatus is as follows:—Thin strips or pieces of lead of any convenient size are placed in a suitable chamber or house. At any convenient distance from this chamber and connected thereto by a pipe or pipes, or within the chamber itself, is placed a vessel, reservoir, or receptacle of any suitable form or shape containing acetic acid of any suitable strength; carbonic acid gas, either pure or mixed with oxygen or with common air, is forced through a suitable pipe or pipes into the said receptacle containing acetic acid, the gas being passed through or over the acid and then passed from the said receptacle freely into the room containing metallic lead for corrosion; steam is likewise introduced at any convenient point and mingled with the gas and vapour.

An improved process and apparatus for extracting and recovering oils, fats, and similar substances. John Cox, analytical chemist, Newcastle-on-Tyne, and Samuel Cox, hydraulic engineer, Hatcham Road, Surrey. January 18, 1873.—No. 214. Our said invention relates to the extraction and recovery of oils, fats, spermaceti, paraffin, wax, and other like substances by the action of a volatile solvent passed by distillation through materials containing these oily, fatty, or other substances, the said volatile solvent being recovered after each operation.

A process for forming carbonic oxide from oxyhydrogen vapour or steam, and an apparatus for utilising the same for heating purposes. Levi Stevens, San Francisco, California. January 18, 1873.—No. 216. This invention consists in the discovery of the conditions by which carbonic oxide or protoxide of carbon is formed from oxyhydrogen vapours or steam. Also in distilling bituminous coal, asphaltum, pine-wood, and in fact any substance that will distil a carbon or hydrocarbon vapour or gas, which vapour or gas is used in the disintegration of oxyhydrogen vapour or steam. The invention further consists in the application of carbonic acid or protoxide thus formed to steam-boilers, furnaces, and all places where heat is required, this being effected by the use of any suitable number of retorts, which are set so as to be heated by the same furnaces which serve for the steam-boilers. These retorts are charged with any suitable or convenient substance which will produce a carbon or hydrocarbon vapour by distillation and at the proper time. Superheated steam (from an apparatus also heated by the furnaces) is let in at a temperature at which the carbon is decomposed. Protoxide of carbon and free hydrogen are thus evolved, and the gases thus produced are led by suitable pipes into the furnaces. Provision is also made for the introduction of oxygen from the air for the complete combustion of the gases thus introduced.

Improvements in stoppering bottles for aerated or gaseous liquids. Charles Farrow, mechanical engineer, Great Tower Street, London. January 18. 1873.—No. 218. This improved stopper is formed by attaching to the ordinary bottle a tube of flexible or elastic material, such as india-rubber, or india-rubber lined with linen, one end of this tube being passed over and attached to the neck of the bottle by string or wire. To close the bottle, the upper part of the tube may be either doubled down and tied, or strangled.

An improvement in pediment or cistern barometers, and in the means of filling the same. Christopher George, Staff-Commander R.N., Herne Hill, Surrey, and Henry Porter, optician, Strand, Middlesex. January 18, 1873.—No. 224. The cistern is made open at bottom, so that when fitted on the mouth of the tube, and the two inverted, the mercury may be poured into the tube without the use of a funnel, a twisted or spiral cord having been first introduced into the tube. This cord has a brush or feather at its extremity, which reaches the closed end of the tube, and the mercury on being poured in is broken up into globules, which pass down between the cord and the sides of the tube. The cord is then rotated in the tube, which raises it out of the mercury bringing with it all air-bubbles. When the tube is filled, the cistern is closed by a vulcanised india-rubber stopper, and the instrument brought to its proper position.

A new or improved charcoal to be used for purifying sewage and other foul waters, and for disinfecting and deodorising purposes. James Robey, sugar refiner, Manchester. January 20, 1873.—No. 230. The features of novelty in this invention consist in drying and charring the sludge or precipitant obtained by treating sewage after the manner of the Native Guano Company, Limited, when practising according to either of the two patents granted to Messieurs Sillar and Wigner, bearing date June 15, 1868, No. 1054, and to W. Wigner, bearing date May 12, 1870, No. 1354, in both of which patents clay is the principal precipitant, or the sludge or precipitant obtained by treating sewage by other precipitating processes in which clay is used, and so producing a charcoal which is useful for the various purposes described; or a similar charcoal is produced by mixing clay with the refuse carbonaceous matter from prussiate of potash manufactories, and then charring the mixture.

An improved process for obtaining salt of tin and other products from waste or refuse tin-plate. Adolf Gutensohn, analytical chemist, Gresham House, London. January 22, 1873.—No. 258. I use a vessel made of any material not affected by the action of acids. In this vessel I place the tin-plate or refuse with muriatic acid until it has acquired a dull grey colour; the acid is then poured off into a second vessel containing the same weight of tin-plate waste; here it again remains till the colour of the waste is dull grey; after which the same process is repeated in a third vessel. Ammoniac is added until, on testing with a solution of extract of indigo, a blue-black deposit is formed. A further quantity of the solution of extract of indigo is then added until the deposit ceases to be formed. The solution is then allowed to boil for a few minutes, and then filtered. This solution is then evaporated, and the salt allowed to crystallise. Metallic tin is obtained from the purified salt of tin by means of zinc.

Improvements in the manufacture of incombustible paper, in ink for writing on the same, and in covers and envelopes for the said paper or other paper when made into books or packages. George William Halfpenny, 25, Lower Shadwell, Middlesex. January 23, 1873.—No. 262. The chief features of novelty in this invention are—First. The making of a paper which shall be ordinarily incombustible under such circumstances as fires occurring in dwelling-houses, factories, and other buildings. The paper is composed chiefly of the following ingredients, viz., linen or vegetable fibre and asbestos with borax and alum, to which is sometimes added a small quantity of ground or powdered glass and of common salt Secondly. An ink for writing on the above paper made from the mineral or metallic earths. Thirdly. Incombustible covers or envelopes for books and packages made from the incombustible pulp or paper with or without sheets of talc or sheets of talc with or without the incombustible paper.

Improvements in treating sewage for the purpose of making manure and purifying sewage. Frederick Jacobsen, Redfern House, Edinburgh. January 23, 1873.—No. 266. Mixing phosphate of lime along with diluted sulphuric acid, which sulphuric acid is so diluted with sewage instead of with clean water, whereby a superphosphate is produced, which is then mixed with the more solid sewage deposit obtained by any of the known methods for producing subsidence and decantation.

TO CORRESPONDENTS.

*** The STUDENTS' NUMBER of the CHEMICAL NEWS will be published on Friday, September 12th. Gentlemen holding official positions in the Universities, Medical Schools, &c., of the United Kingdom, where Chemistry and Physical Science form a part of the Education, who have not yet forwarded the necessary information to our office for publication in that number, will confer a favour by sending it with the least possible delay,

*** Vol. XXVII. of the CHEMICAL NEWS, containing a copious index, is now ready, price 11s. 4d., by post, 12s., handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxviii. commenced on July 4th, and will be complete in twenty-six numbers. READING CASES, price 1s. 6d. each, post free, may also be obtained at the Office.

SUPPLEMENT
TO
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Vol. XXVIII. No. 719.

ESTIMATION OF HYDROSULPHURIC ACID IN MINERAL WATERS.

By W. J. LAND.

In an apartment free from direct sunlight, preferably a room lighted by non-actinic rays, prepare a moist precipitate of *pure carbonate of silver*, by dissolving 8·5 grms. of pure nitrate of silver in one-fourth of a litre of distilled water; also, 2·7 grms. of chem. pure dry carbonate of soda in an equal volume of distilled water previously heated to about 180° F. Mix the solutions (gradually), simultaneously stirring the mixed solutions with a glass rod. Allow the precipitate to subside, decant the supernatant liquid with a pipette or small syphon, wash with hot distilled water, decanting and washing successively five or six times to obtain a comparatively clean precipitate of carbonate of silver, in which substance we have a most excellent reagent for removing every trace of hydrosulphuric acid, small quantities of alkaline sulphides and haloids, from their solution in water. Add, to a definite quantity of the water to be operated upon (say 1 litre if strongly impregnated, and 10 litres if weakly impregnated with gas), the still moist precipitate or *magma* of carb. of silver, until the precipitate, at first black in colour, becomes brown or greyish-brown, thus indicating an excess (as desired), of the silver salt. Shake or stir well, warm gently, and allow the precipitate to subside perfectly. Decant the greater part of the liquid, transfer the remainder of the liquid with every trace of the precipitate to a small beaker, and digest the latter with pure dilute nitric acid (1 of acid to about 4 of water), thus removing the excess of carbonate of silver. Decant and wash well with distilled water. Transfer to a weighed filter, wash with a moderately dilute solution of hydrate of ammonia (to remove silver haloids), testing the ammoniacal filtrate occasionally with sulphide of ammonium, or other suitable reagent, to discover the presence or absence of the silver haloids in the washings; when all traces of these have disappeared, wash well with distilled water; lastly, with pure 95 per cent alcohol, dry on a water-bath. Remove the dried sulphide of silver from the filter, ignite the latter in a small porcelain crucible with a grain or two of sulphur; heating to incipient redness (to expel excess of sulphur), add the ignited product to the larger quantity of the precipitate, transfer to a desiccator, afterwards weigh. 124 of the sulphide corresponds to 17 of hydrosulphuric acid sought.—*American Chemist.*

NOTICES OF BOOKS.

The Chemistry of Sulphuric Acid Manufacture. By H. A. Smith. London: E. and F. N. Spon.

That sulphuric acid plays in chemical manufactures a part analogous to that sustained by iron in the mechanical arts is not to be disputed. Such being the case it is surprising that every point connected with its production has not been thoroughly studied both from a theoretical and practical point of view. Yet the author of this useful little work says no more than the truth when he declares that:—"The interior of the lead chamber is comparatively an unknown land to us." Mr. Smith, in the brief compass of 81 pages, has made a very praiseworthy attempt to supply this deficiency in our knowledge, and we hope that he may find time and opportunities to carry out and complete what he has so well begun.

The first part of the work is devoted to a consideration of the presence of arsenic in the sulphur ores commonly employed. The amount of this serious impurity he finds to be greater than is generally stated in standard works, ranging from 0·943 per cent in Belgian pyrites to 1·878 in Westphalia. The author's determinations certainly accord much better with the amount of arsenious acid present in commercial sulphuric acid, hydrochloric acid, salt-cake, and other products and residues implicated than do the analyses given in Richardson and Watts's "Chemical Technology." In that important work the highest mean percentage of arsenic is described as ranging from 0·31 to 0·33, whilst some pyrites are described as containing mere traces, and others as perfectly pure, "results which," our author remarks, "are never corroborated when these ores are being worked on a manufacturing scale." The means for preventing the escape of arsenious acid into the atmosphere, and of removing it from sulphuric acid, are carefully investigated. The preference is given to the use of sulphuretted hydrogen, though the mode of its application is still an open question.

We next come to an "experimental examination of the circumstances which determine the action, *inter se*, of the gases in the lead chamber." The author, founding on careful experiments, controverts the common view that no action can take place between oxygen and sulphurous acid gases without the intervention of water, either in the liquid or gaseous state. He finds, on the contrary, that "action does take place between the dry gases under certain circumstances." He draws here the general practical rule that, "the higher the temperature the more steam is required."

In successive sections we find experimental investigations into the distribution of gases in the lead chambers, the temperature at which nitric acid acts upon sulphuric acid, the distribution of heat in the chambers, and an inquiry into the best form of chamber. We quote the following as his practical conclusions:—

1. The best form of chamber is one which is long and not high, of somewhat the following dimensions:—Length 150 feet, width 25 to 30 feet, height 10 or 12 feet.

2. The temperature of the chamber should be kept as nearly as possible about 200° F.; this fact also acting as a regulator for the amount of steam thrown into the chamber.

3. That in "starting" a chamber sulphuric acid should be run on the bottom in preference to water as at present generally employed."

In a final section on the Gay-Lussac tower and the escape of sulphurous acid to the atmosphere, he condemns the tower on the following just principle:—"Instead of a careful inquiry into the cause of the escape of nitric oxide, we take it as a recognised fact that such a gas *must* escape, and that our only hope rests in some method of absorbing it. Referring to the present escape of sulphurous acid from alkali works, the author recommends a prohibitory law similar to the Alkali Act. Whilst fully admitting both the nuisance and the waste thus occasioned, we cannot help asking what proportion does the sulphurous acid escaping from chemical works bear to that evolved from the pyrites present in coal? Our conviction is, that in any district where the highly sulphurous Lancashire coal is used the former is a mere "drop in the bucket."

We strongly recommend this treatise to all of our readers who are interested in the manufacture of sulphuric acid, and we hope that its practical, experimental spirit may be reproduced by writers on other departments of chemical technology.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, August 11, 1873.

On Cyanides.—M. Berthelot.—A continuation of the thermo-chemical investigations with which the author has been occupied for some time. The author mentions as an important instance of an "inverse displacement" that hydrocyanic acid displaces hydrochloric acid from combination with the oxide of mercury. On the other hand, concentrated hydrochloric acid, and even hydrochloric gas, expel immediately, and at ordinary temperatures hydrocyanic acid from cyanide of mercury; and dilute aqueous hydrochloric acid completely decomposes cyanide of potassium in solution. These facts, he contends, are in perfect accord with his theory.

Re-solution of Precipitates.—M. Berthelot.—The theory of Berthollet as given in his "Statique Chimique" is that if we treat a dissolved salt with an acid capable of forming an insoluble salt with its base the latter is generated in consequence of the partition of the base between the two acids, and is then precipitated in virtue of its insolubility. The separation of this body having withdrawn it from the field of chemical action, a fresh partition of the base takes place between the two acids in the liquid, and consequently a fresh precipitation. This is still the admitted law of the science. The thermic theory, on the other hand, reproduces the notion of an elective affinity; the work done by which is measured by the heat liberated in the reactions of the bodies taken in comparable states. If the bodies were isolated from every solvent, and if each acid formed with the base only one single compound, there would be no partition—contrary to the opinion of Berthollet—and, in consequence, insolubility would not play any part in chemical statics. It would be the same in the presence of water if none of the compounds formed in its absence did not undergo decomposition on its part. But there are acids capable of forming several compounds with one and the same base. Further, water decomposes in part according to its mass, and to the relative proportions of acid and of base, the acid and the basic salts, the ammoniacal and the metallic salts, &c. These circumstances determine intermediate equilibria; that is to say, a varying partition of the base between the two acids. In solutions, and for soluble salts, the reality of this partition can be established by thermic evidence (*Comptes Rendus*, tome lxxv., p. 435, 480, 508, 583; tome lxxvi., p. 94); or by the method of two solvents (*Annales de Chimie et de Physique*, 4 series, tome xxvi., p. 433). To decide between these theories we must seek cases where they lead to conflicting results, such as those where each of the two antagonistic acids forms only a single basic compound stable in presence of water. The proof is realised by mixing acetate of silver and dilute nitric acid, when the insoluble acetate is immediately changed into dissolved nitrate. It would be easy to multiply analogous examples of the complete displacement of a monobasic acid in an insoluble salt by a single equivalent of another monobasic acid which forms an insoluble salt. The decomposition of insoluble carbonates by monobasic acids, such as the hydrochloric and nitric, in liquids either concentrated or so dilute that the carbonic acid may remain dissolved, is equally total. In dilute solutions it gives rise sometimes to a liberation of heat, sometimes to an absorption (carbonate of silver and nitric acid). The decomposition of the insoluble carbonates falls under the foregoing theory. Such results may serve as a criterium between the theory of Berthollet and the new thermic theory.

Methods of Analysing the Natural Phosphates employed in Agriculture.—M. C. Mène.—The author has already called attention to the analysis of phosphates by the "ammonia" and the "citric acid" (or acetic) methods, and to the erroneous results to which these methods may lead (*Comptes Rendus* tome lxxvi., p. 1410). He now produces results of analyses made in his laboratory which confirm what he formerly announced. Coprolites from the Department Nord, found to contain 45 per cent of tricalcic phosphate by the citric acid and ammonia phosphate of magnesia process, gave only traces of phosphoric acid by the "bismuth process." Other phosphates from the Rhone giving 53 per cent of phosphate by the citric method, did not yield even a trace of phosphoric acid by the bismuth process. If an attempt was made to check the results obtained by the former method by re-dissolving the precipitate, and trying to produce other reactions no phosphoric acid could be found. On the contrary, it appeared that this precipitate was silica and alumina. If any one goes over the details of the process he will see that the ammoniacal liquor which serves to precipitate the ammonia phosphate of magnesia, throws down also alumina and silica, and that in the absence of phosphoric acid these two bases (?) may simulate its presence. The author, however, does not attack the citric acid method in cases where silica and alumina are absent, having frequently obtained by its means with the phosphates of the Antilles, and of Limburg, with bones, &c., results quite comparable to those given by the bismuth process. He considers that bismuth precipitates phosphoric acid so quickly and certainly that no other reagent can be compared with it. In many determinations he has never found a deviation of more than 0·25 per cent, which is commercially inappreciable.

On Fluoren.—M. Barbier.—Fluoren, a new and highly fluorescent carbide, is contained in the parts of coal-tar which are volatile between 300° and 340°; its formula is $C_{26}H_{10}$. On treatment with chlorine it forms a bibromic derivative, $C_{26}H_8Br_2$, fusible at 166° to 167°, and crystallising in splendid tables belonging to the clinorhombic system.

Corindon of North Carolina, Georgia, and Montana.—Lawrence Smith.—Specimens of this mineral have been found in crystals of a pyramidal form. They vary greatly in colour, being grey, green, rose, blue, red, with all intermediate shades. Diaspore, so abundantly associated with corindon at Chester (Massachusetts), has not been found accompanying it here. Specimens supposed to be diaspore were colourless kyanite. Chlorite envelopes and penetrates the corindon. It composition is—

	Large Plates.	Friable.
Silica	27·00	29·15
Alumina	21·60	10·50
Oxide of iron ..	16·63	23·50
Magnesia	22·00	25·44
Water	12·30	10·04

Margarite (emerylite) accompanies corindon or emery everywhere; in the present localities it is abundant. Its composition is:—

Silica	32·41
Alumina..	51·31
Lime	10·98
Soda	2·43
Water	2·13

Zoisite.—This mineral appears in two forms; a black and a transparent green variety. Both of these have been called *Arfvedsonite*, but neither has the composition of that mineral. The following is the composition of three kinds:—

	Transparent Green.	From Geneva.	Black Variety.
Silica	45·70	43·59	45·90
Alumina	24·01	27·72	13·34
Peroxide of iron	4·56	2·61	11·46
Lime	13·34	21·00	12·20
Magnesia ..	8·03	2·40	12·53
Soda	2·91	3·08	3·39
Water	0·60	—	0·66
Chromic oxide	0·52	—	—

Andesite.—This mineral is found in a granular form. Its composition is—

Silica	64·12
Alumina	24·20
Soda	9·28
Lime	2·80
Oxide of iron	0·14

Action of Platinum and Palladium on the Hydrocarbides.—J. J. Coquillion.—It is known that a spiral platinum wire, previously heated to redness and placed in contact with vapours of alcohol or ether, gives rise to a variety of products, of which the chief are aldehyd and acetic acid. All the mono-atomic alcohols and their ethers act in an analogous manner, producing the aldehyd and the acid corresponding to the alcohol. All the hydrocarbons, the volatile oils, anilin, &c., maintain the incandescence of the platinum spiral. The fixed oils, the sulphuretted oils, such as those of garlic and mustard, seem to form an exception. The author has collected the products of combustion in the case of three substances belonging to three different series—toluen, $C_{14}H_8$, of the series $C_{2n}H_{2-n6}$; formen, C_2H_4, of the series $C_{2n}H_{2n+2}$; and ethylen, C_4H_4, of the series $C_{2n}H_{2n}$. Toluen gives up 2 equivalents of hydrogen to form water with the oxygen, and yields aldehyd and benzoic acid. Formen yields formic acid, and ethylen produces acetic acid. The action of palladium is more powerful than that of platinum. It becomes wrinkled on its surface, and breaks easily after having been in use for some days; moreover, it loses weight very distinctly.

Reply to Recent Objections of M. Tacchini (Solar Physics).—M. Faye.—First, as to penumbræ. M. Faye's theory is that they are due to a lowering of temperature about the solar vortices. The photosphere somewhat altered is continued to a certain depth in the form of a sheath round the vortices. When by some accident, as sudden increase of intensity, or extended rotation, these conical walls are reached they may take for a time a well-marked vertical movement; but in general they have only a slight hardly perceptible rotation. Hence it is not surprising that in the first five months of the present year, M. Tacchini observed only six cases of vortical structure. Again, M. Tacchini supposes M. Faye's theory requires a symmetry in the mode of rise of the hydrogen in the spots, and that there should always be a well-formed corona of protuberances. M. Faye rejects this idea; the sun's structure, and the analogy of terrestrial cyclones are both against it. M. Faye is represented, thirdly, as holding that there are never protuberances without spots. He quotes various passages from his writings contradicting this.

Direct Demonstration of the Fundamental Principles of Thermo-Dynamics.—Continued extract from memoir by M. Ledieu.—It treats of quantities which characterise—(1) The absolute temperature of a body; (2) its physical and constitutive state.

Detailed Geological Map of France.—M. Elie de Beaumont.

Note on the Public Works of the United States of America.—M. Belgrand.—The author notices some points (referring to bridges, water-works, railways), in the report of M. Malezieux, a French engineer sent over by the Government in 1870.

Propagation of the Tide at Different Points on the French Coast.—M. L. Gaussin.—(Extract from memoir.)—The author examines the tidal phenomena in about a dozen French harbours and four English. As to ocean ports (Cordouan, Saint Nazaire, Port Louis, &c.) the tide is propagated more slowly in still than in current water. In the Channel, on the contrary, except at Havre, the tide arrives more quickly in still water on both coasts. Further North on the German Ocean, at Calais, and at Dunkirk the former *regime* recurs. The author gives the average variations of retardation in the daily tides, the syzyzial tide being taken as normal type. Comparing the curve for Havre with that for the neighbouring port of Fecamp, the minimum for the former and maximum for the latter takes at syzyzies; the Havre minimum, + 34 m., corresponds to the Brest tide of 11h. 30m.; the Fecamp minimum, − 23m., corresponds to the tide of 11h. The difference of variations of retardation in the propagation of the tide in the two ports is thus, in relation to the tide in current water, 57m. in still water. Formerly, before certain embankments were constructed in the Seine, it was only 33m. There is, besides, an absolute change at Havre. In current water the full sea reaches Havre 36m. more quickly than before. These changes are attributed to considerable diminution in the beaches of the Seine estuary, which have exerted a retardative action, and do still, though in less degree.

Passage of Gases through Colloidal Membranes of Vegetable Origin.—M. A. Barthelemy.—The author repeated the experiments which Graham made with caoutchouc, with leaves of certain varieties of *Begoniaceæ*. Though it was difficult to preserve in the several experiments the same conditions of external pressure, temperature, and hygrometric state, the numbers sufficiently show that oxygen passes more quickly than nitrogen, and that air thus dialysed contains, on an average, 36 per cent oxygen (a number slightly under that which Graham obtained with caoutchouc). In another experiment, having made CO_2 pass over the membrane, he marked the point to which mercury descended in an hour; then passing nitrogen or oxygen, he marked how long the mercury took to descend to the same level. The results closely agreed with Graham's; and warrant the conclusion that the natural colloidal surfaces of plants have for CO_2 an admissive power 13 to 15 times greater than that for nitrogen, and 6 to 7 times greater than that for oxygen. Carbonic anhydride passes less quickly than hydrated carbonic acid. The author remarks that "cuticular respiration appears sufficiently proved by the presence of colloidal membrane in all organs; by the similarity (physical and chemical) between this membrane and caoutchouc; by Graham's experiments; by measurements of the passage of gas through colloidal membrane; and last by M. Boussingault's experiments, which attribute to the upper surface of leaves, devoid of stomates, a decomposing power greater than that of the under face covered with these small orifices.

Variations of Hæmoglobin in Disease.—M. Quinquaud.—In a healthy person the proportion of hæmoglobin is about 125 to 130 grs. per 1000 grs. of blood. But it varies very much in disease; sometimes, as in cancer, falling as low as 38 grs. It may thus serve, M. Quinquoud thinks, in diagnosis and prognosis. He gives several instances, and adds a determination of the hæmoglobin for some twenty different kinds of disease. Cancer, chlorosis, and tubercular phthisis of the third degree, are those which diminish the proportion most.

Revue Scientifique de la France et de l'Etranger, August 9 and 23, 1873.

These numbers contain no original chemical matter.

No. 9, August 30.

Meeting of the French Association for the Advancement of Science at Lyons.—(Chemical Section).—Session of August 22.—M. Gautier described a new derivative of glucose, $C_{12}H_{22}O_{11}$, obtained by the action

of hydrochloric acid. The glucose is dissolved in alcohol at 95 per cent; and the solution saturated with hydrochloric acid, keeping the temperature at 0°. The mixture, after having been kept cold for twenty-four hours, is evaporated over lime in a vacuum, when there remains a syrup which is purified by washings in ether, treatment with baryta, and successive solutions and evaporations in absolute alcohol. The compound is a white, crystalline, solid, deliquescent mass, without taste, incapable of fermentation, reducing cupro-potassic liquid, and not capable of becoming hydrated below 160°, when it is converted into a body differing from glucose. This compound, resulting from the union of two molecules of glucose with the elimination of a molecule of water, does not appear to be an ether of glucose viewed as an alcohol, but as a body like aldol, analogous to the products yielded by the aldehyds. M. Gautier proposes to give it the name glycaldan.

With reference to this paper M. Wurtz explained the constitutional formulæ of glucose, which explains its double function as a pentatomic alcohol and as an aldehyd.

E. Grimaux stated that Musculus had obtained by the action of sulphuric acid upon glucose a body which appeared to be dextrin; resulting from the union of two molecules of glucose, performing the functions of an alcohol, with separation of a molecule of water.

Ch. Girard presented to the section specimens of certain coal-tar colours, such as rosanaphthylamin, saffranin, Paris violet, &c., and described the method of their preparation.

M. Carnot described a deposit of bismuth which is worked at present at Corrèze. It consists of metallic bismuth, oxide, and sulphide. The oxide is the most abundant ore, and contains 70 per cent of bismuth. The process of extraction consists in exhaustion with hydrochloric acid, and precipitation by means of iron. The bismuth then undergoes the ordinary treatment for the removal of lead and arsenic. The stratum contains also molybdate of lead, tungstate of lime, and mispickel.

M. Friedel has examined two samples of rich tellurium ores from Asia Minor. The ore is a telluride of gold and silver, containing 21 per cent of gold, and 37 per cent of silver. The other is a telluride of lead.

M. Grimaux described the action of bromine upon dimethylbenzin or xylen, $C_6H_4(C_6H_3)_2$, at the temperature of 140°. He showed that whilst forming a bibromated derivative, the bromine substitutes itself in the two groups CH_3, yielding a dihydrobromic ether of glycol. The author announced that he had observed the same reaction with ethyl-benzin, $C_6H_5-CH_2-CH_2$, which yields a derivative, $C_6H_5-CHBr-CH_2Br$, identical with the bromide of cinnamen. This bromide, on boiling with water, loses all its bromine in the state of hydrobromic acid, and forms a very soluble crystalline body, probably cinnamenic glycol. The same procedure, applied to trimethyl-benzin or to ethyl-methyl-benzin, would doubtless lead to the formation of a tribrom-hydrin of an aromatic glycerin, but the author has had recourse to another reaction for the production of the latter.

Cinnamic alcohol or styron, $C_9H_{10}O$, may be considered as phenyl-allylic alcohol. Like allylic alcohol it fixes 2 atoms of bromine, and yields a crystalline dibromhydrin, $C_9H_{10}Br_2O$. Grimaux has also obtained tribromhydrin, aceto-dibromhydrin, and chloro-dibromhydrin, all crystalline. Triacetin is a syrup-like liquid. The glycerin, $C_9H_{12}O_3$, obtained by the action of water upon dibromhydrin is a soft transparent gummy substance of a bitter taste, very soluble in water, and which behaves with formic acid similar to the polyatomic alcohols, setting free carbonic acid. The author gives to this glycerin the name of stycerin.

Revue Hebdomadaire de Chimie Scientifique et Industrielle par Ch. Mène, May 22, 29, and June 5, 1873.

These numbers contain nothing of interest to our readers.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 249, September, 1873.

Report given in by M. Salvetat for the Committee of the Chemical Arts on a New Form of Muffle for Burning Designs on Porcelain, Earthenware, Glass, and Crystal.—M. Pollard, at Auteuil.—This paper would not be intelligible without the accompanying diagrams.

Report Given in by Hervé Mangon for the Committee of Agriculture on the Procedures of Preparing Animal Matters Designed for the Manufacture of Manures.—M. Coignet.—Horns, hoofs, hair, refuse of tanned hides, and woollen rags are very rich in nitrogen and other fertilising ingredients; but the difficulty of reducing these matters to a fine powder so as to mix with the soil, and the extreme slowness of their decomposition in the ground, prevent them from giving a profit in proportion to the value of their constituents. M. Coignet seeks to overcome these difficulties as follows:—Leather waste of all sorts, horn, and analogous matters are introduced into a stove of about 20 cubic metres in capacity. This stove is of sheet-iron. It has at its upper part a door for charging, and a side door below for emptying. A floor of bricks is formed at some decimetres above the bottom of the stove. The lower part of the stoves communicates, by means of a large sheet-iron pipe, with the chimney of the works, or with an aspirating ventilator. By the side of the stove is a rectangular furnace in which coke is burnt, the chimney of which opens into the upper part of the stove above-mentioned. The hot air and the products of combustion traverse the contents of the stove from the top to the bottom. When the stove is filled, and its doors are closed and luted, the furnace is kindled, and the doors placed above the fire are opened so that a large volume of air may enter the stove at a temperature not exceeding 150°. When the whole mass of the stove has reached this temperature the furnace is well charged with coke, and its doors are closed so as merely to admit air sufficient to prevent it from being extinguished. At the same time a current of steam is allowed to enter the chimney (leading from the furnace to the stove). This steam mixes with the products of combustion, and traverses thus the stove at a temperature of 150° to 160°. After some hours of this treatment the horn, leather, &c., is found slightly swelled, and quite dry and friable, without having lost any nitrogen. The mass is allowed to cool, withdrawn from the stove, powdered under edge-stones and sifted.

On Blast-Furnaces.—M. L. Gruner, Inspector-General of Mines.—A long and important paper, with several illustrations, and not suited for abstraction.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxi., No. 17, August 21, 1873.

This number contains no original chemical matter.

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THE CHEMICAL NEWS.

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(STUDENTS' NUMBER.)

SCIENCE IN THE UNIVERSITIES.

The Third Report of the Commission on Scientific Instruction and the Advancement of Science relates exclusively to the Universities of Oxford and Cambridge. The Commissioners at the outset of their report draw a necessary distinction between Science as limited by the scope of the duties assigned them, and "the mental and moral sciences, as well as those parts of human knowledge and culture which are not usually regarded as having any scientific character."

The report is too voluminous, and the subjects to which it relates are too important, to permit of our dealing with all the matters considered in it. We select, therefore, those which, in our opinion, are of primary importance.

It will not surprise those who have seen the previous reports of the Commission to hear, that, in considering what may be regarded as the connecting link between school and college careers, the Commissioners expressing a preference for an examination at leaving school to college matriculation examinations, insist strongly on the importance, for the future, of scientific education in England; that, in case such an examination should be instituted, those parts of science which are suitable for the education of boys should be recognised in it. Passing thence to the question of the university curriculum, they present the arguments for and against the desirability of insisting on a certain amount of literary culture in the case of scientific students. The Commissioners, while expressing their opinion that some evidence of literary culture should be required by the University from every student, urge that the principle should be extended, and that, "in like manner, evidence of corresponding scientific culture should be required from the student of classical literature or of theology." It is urged, however, that the student of any special department should be freed at an early period of his university career from any obligatory subjects of study.

Passing over the suggestion that scholarships should be founded in natural science, we come to an extremely important part of the report—the discussion, namely, of the existing arrangements for science teaching at the two universities. We notice, with strong approval, that, in passing, the Commissioners draw attention to the possible mischief resulting from the influence of the competitive mathematical examination at Cambridge. "It does not seem probable," they justly notice, "considering the keenness of the competition for high places in the mathematical tripos, that students would be willing to interrupt their more direct preparation for examination by attending numerous courses of professors' lectures." The Commissioners evidence also the existing state of the scientific institutions at the two universities, and although they do not express absolute dissatisfaction, they indicate their opinion that our universities fall short of the standard of excellence attained elsewhere.

But perhaps the most noteworthy, as it is certainly the most critical (we do not say questionable) proposition in the whole report, is contained in the following paragraph:—

"It is, in our opinion, most important that a certain number of fellowships should be appropriated to the direct promotion of learning and research in various directions. It has been objected to this proposal that the fellowship system, as hitherto administered, has not shown any great tendency to encourage original research, either in the field of learning or in that of science; that when an office is created simply and solely with the view of giving a man leisure for original research, there is always the appearance, to say the least, of creating a sinecure; and that it is impossible, as Professor Jowett has said, to get a man for money who can make a discovery. But, though you cannot get a man for money to make a discovery, you may enable a man who has shown a special capacity for research to exert his powers; and we are of opinion that, unless an effort is made to do this, one of the great purposes for which learned bodies, such as the colleges, exist, may run the risk of being wholly lost sight of." The Commissioners do not state what this purpose is, nor are we aware of any purpose, legitimately included in the general object for which colleges have been founded, which can be said to call for the foundation of research fellowships. It may be highly desirable that such fellowships should be established, and convenient that a portion of the wealth of our colleges should be applied to the promotion of original research; but it can scarcely be said that, when the colleges were first established, any such purpose was in view. "Scientific discoveries," proceed the Commissioners, "rarely bring any direct profit to their authors, nor is it desirable that original investigation should be undertaken with a view to immediate pecuniary results. 'Research, as Lord Salisbury has observed 'is unremunerative; it is highly desirable for the community that it should be pursued; and therefore the community must be content that funds should be set aside to be given, without any immediate and calculable return in work, to those by whom the research is to be pursued.' It may be that properly qualified candidates for such scientific offices would not at first be numerous, but we believe that, eventually, a considerable number of fellowships might be advantageously devoted to the encouragement of original research."

We must confess to some feeling of anxiety as to these suggestions. As an abstract proposition, it appears reasonable enough to assert that scientific workers should be helped in the manner indicated. But certain recent events have made it but too manifest that, so soon as a scheme for such a purpose comes to be definitely propounded, the men who will show in front among the claimants for this species of assistance will not be the really earnest workers in science, but the scientific Micawbers, who work at science under the continual hope that "something will turn up" for their own special advantage. Proposals savouring of self-interest have already shown what might be expected if ever any wide scheme for the appropriation of college funds to scientific research were set on foot. Any

mischief wrought in this way, any circumstance by which the name of science would be brought into contempt, would be almost irreparable, especially as occuring just at the outset of the new arrangements by which it is hoped that, ere long, the real interests of science will be notably advanced.

With this exception, the report before us is, in our judgment, eminently satisfactory. There can be no question that the relations of our universities to science are at present not all that could be desired, and that they admit of ready improvement. The suggestions offered to this end by the Commissioners are reasonable and moderate; there is nothing in them to offend what may be called university susceptibilities, although they are not all such as the thorough going university man would accept. The mere fact, however, that not a few among the suggested alterations have come from and have had the support of men high in position in our universities, shows that the interests of these bodies have not been lightly regarded. We have very little doubt that good results will follow from the labours of the Commissioners; and if we have found reason to criticise one feature of their report, it is only because we would desire to see removed all risk that jobbery might one day become an element in the election to university fellowships, and that thus the interests of science would suffer instead of being advanced by the proposed arrangement.

SCHOOLS OF CHEMISTRY.

EXAMINING BOARDS.

UNIVERSITY OF LONDON.

Candidates for any Degree granted by this University are required to have passed the Matriculation Examination, to which no candidate is admitted unless he has produced a certificate showing that he has completed his sixteenth year.

The Fee for this Examination is £2.

The Examination will be held on Monday, January 12th, 1874, and includes the following subjects:—

Mathematics.

Arithmetic—

The ordinary Rules of Arithmetic.

Vulgar and Decimal Fractions.

Extraction of the Square Root.

Algebra—

Addition, Subtraction, Multiplication, and Division of Algebraical Quantities.

Proportion.

Arithmetical and Geometrical Progression.

Simple Equations.

Geometry—

The first four books of Euclid, or the subjects thereof.

Natural Philosophy.*

Mechanics—

Composition and Resolution of Statical Forces.

Simple Machines (*Mechanical Powers*): Ratio of the Power to the weight in each.

Centre of Gravity.

General laws of Motion, with the chief Experiments by which they may be illustrated.

Law of the Motion of Falling Bodies.

Hydrostatics, Hydraulics, and Pneumatics—

Pressure of Liquids and Gases, its equal diffusion, and variation with the depth.

Specific Gravity, and modes of determining it.

The Barometer, the Syphon, the Common Pump and Forcing-Pump, and the Air-Pump.

Optics—

Laws of Reflection and Refraction.

Formation of Images by Simple Lenses.

Chemistry.

Heat—its sources. Expansion. Thermometers—relations between different Scales in common use. Difference between Temperature and Quantity of Heat. Specific and Latent Heat. Calorimeters. Liquefaction. Ebullition. Evaporation. Conduction. Convection. Radiation.

Chemistry of the Non-Metallic Elements; including their compounds as enumerated below—their chief physical and chemical characters—their preparation—and their characteristic tests.

Oxygen, Hydrogen, Carbon, Nitrogen. Chlorine, Bromine, Iodine, Fluorine. Sulphur, Phosphorus, Silicon.

Combining Proportions by weight and by volume. General Nature of Acids, Bases, and Salts. Symbols and Nomenclature.

The Atmosphere—its constitution; effects of Animal and Vegetable Life upon its composition.

Combustion. Structure and Properties of Flame, Nature and Composition of ordinary Fuel.

Water. Chemical peculiarities of Natural Waters, such as rain-water, river-water, spring-water, sea-water.

Carbonic Acid. Carbonic Oxide. Oxides and Acids of Nitrogen. Ammonia. Olefiant Gas, Marsh Gas, Sulphurous and Sulphuric Acids, Sulphuretted Hydrogen.

Hydrochloric Acid. Phosphoric Acid and Phosphoretted Hydrogen. Silica.

Classics.

The Greek and Latin Languages—

One Greek and one Latin subject, to be selected by the Senate one year and a half previously from the works of the undermentioned authors:—*

Homer	One Book.
Xenophon	One Book.
Virgil	One Book of the Georgics, and one Book of the Æneid.
Horace	Two Books of the Odes.
Sallust	The Conspiracy of Catiline, or the War with Jugurtha.
Cæsar	Two Books of the Gallic War.
Livy	One Book.
Cicero	De Senectute or De Amicitiâ, with one of the following Orations:—Pro Lege Manilià, either of the four Catilinarian Orations, Pro Archiâ, Pro M. Marcello.
Ovid	One Book of the Metamorphoses, and one Book of the Epistles or Heroides.

The Paper in Greek shall contain passages to be translated into English, with questions in Grammar, History, and Geography. The Paper in Latin shall contain passages to be translated into English, with questions in History and Geography. A separate Paper shall be set containing questions in Latin Grammar, with simple and easy sentences of English to be translated into Latin.†

The English Language—

Orthography. Writing from Dictation. The Grammatical Structure of the Language.

Outlines of English History and Modern Geography—

History of England to the End of the Seventeenth Century, with questions in Modern Geography.

The French or the German Language—

At the option of the Candidate.‡

* The Questions in Natural Philosophy will be of a strictly elementary character.

* The Classical Subjects for 1874 are—For January, 1874:—*Homer*, Iliad, Book xxiv.; *Cicero*, De Senectute, and the Third Catilinarian Oration. For June, 1874:—*Xenophon*, Anabasis, Book v.; *Virgil*, Georgics, Book iv., and Æneid, Book vi.

† Special stress is laid on accuracy in the Answers to the Questions in Greek and Latin Grammar.

‡ At the next Matriculation Examinations (January, 1874; June, 1874; and January, 1875) credit will be given to Candidates for Greek in addition to either French or German.

The Papers in French and German shall contain passages for translation into English, and questions in Grammar (limited to the Accidence) on subjects furnished by those passages.

Candidates shall not be approved by the Examiners unless they have shown a competent knowledge in each of the following subjects :—

1. The Latin Language, with Grammar, History, and Geography.
2. Either the Greek Language, with questions in Grammar, History, and Geography; or the French or the German Language, with questions in Grammar.
3. The English Language, English History, and Modern Geography.
4. Mathematics.
5. Natural Philosophy.
6. Chemistry.

Bachelor of Science. (B.Sc.)

This degree is conferred on candidates who pass a satisfactory examination in Mathematics, Mechanical and Natural Philosophy, Botany, and Vegetable Physiology, Zoology, and Chemistry.

First B.Sc. Examination.

No candidate (with the exception of such as have obtained Honours at the Matriculation Examination in the preceding January) is admitted to this examination within one academical year of the time of his passing the Matriculation Examination.

The Fee for this Examination is £5.

The examination will commence on the third Monday in July. It is conducted by means of printed papers; but the Examiners are not precluded from putting, for the purpose of ascertaining the competence of the candidates to pass, *viva voce* questions to any Candidate in the subjects in which they are appointed to examine.

The First Examination includes the following subjects :—

Natural Philosophy.

Heat—

Sources of Heat; conduction—convection.

Effects of Heat: expansion generally—of water—of gases and vapours; liquefaction; vaporisation; latent heat; expansive form of steam; dew-point; gases and vapours compared.

Specific Heat.

Thermometers; Pyrometers.

Heat in the Radiant state.

Electricity—

Sources of Electricity.

Static Electricity; dual character—insulation—induction—specific inductive capacity—equivalent antithetic states—disruptive discharge—convection; Electroscopes—Leyden Jar, &c.

Dynamic Electricity; Conduction—the electric current—derived currents—induction of currents; Voltaic Pile and other voltaic arrangements.

Thermo-Electricity; Electro-Thermometer.

Magnetism—

Magnets, the Earth, &c.; Induction—communication—retention—Magnetic relations of iron, steel, &c.

Electro-Magnetism—as in the spark—in conducting media—in soft iron; Magneto-Electricity; principle of Electro-magnetic and Magneto-Electric machines.

Terrestrial Magnetism.

Inorganic Chemistry.

Matter; simple and compound.

Elementary bodies classed. Metallic and Non-Metallic bodies.

Chemical combination and Mechanical Mixture. Solution.

Outlines of Crystallography. Isomorphism. Dimorphism. Allotropic conditions of matter. Chemical Affinity, Laws of Combination by weight and by volume, as deduced from the history of the individual elements. Equivalent Numbers. Equivalent Volumes. Symbolical Notation, including questions on the Unitary System. Formulæ. Nomenclature.

Chemical actions produced under the influence of Heat. Nature of Combustion. Structures and Properties of Flame. Principles of Illumination. Chemical action of Light. Photography.

Oxygen. Ozone.

Hydrogen. Water.

Nitrogen. Chemical constitution of the Atmosphere. Diffusion of Gases. The Oxides of Nitrogen; Nitric Acid. Ammonia.

Chlorine, Bromine, and Iodine. Their compounds with Oxygen and Hydrogen. Theory of Bleaching.

Fluorine and Hydrofluoric Acid.

Sulphur, Sulphurous Acid. Manufacture and Chemical applications of Sulphuric Acid. Other Oxygen compounds of Sulphur. Sulphuretted Hydrogen.

Phosphorus. Oxygen and Hydrogen compounds of Phosphorus. Theory of Acids. Monobasic, Dibasic, and Tribasic Acids.

Carbon. Carbonic Oxide and Carbonic Acid. The principal Hydrogen compounds of Carbon. Manufacture of Coal Gas.

Silicon and Boron. Their compounds with the elements previously enumerated.

Metals. Characters of Metals as a class. Metallurgical Processes. Alloys. Classification of the Metals.

Potassium. Nitre. Gunpowder. Theory of the action of Gunpowder.

Sodium. Manufacture of Carbonate of Soda.

Barium. Strontium. Calcium. Mortars. Cements.

Magnesium. Aluminum. Glass. Porcelain.

Manganese. Iron. Composition and properties of Cast-Iron, Wrought-iron, and Steel. Chromium.

Cobalt. Nickel. Zinc. Cadmium.

Lead. Manufacture of White-Lead.

Copper. Mercury. Bismuth. Tin. Arsenic. Antimony.

Silver. Gold. Platinum.

Principal compounds of the Metals with the Non-Metallic Elements. Theory of Salts.

Principles of Mineral Analysis.

Principles of Electro-Chemistry.

For the First Examinations, a knowledge of Inorganic Chemistry only is necessary.

Examination for Honours.

Candidates for Honours in Chemistry are examined in any of the following subjects, at the option of the Examiners :—

Elementary Substances and their combinations.

Electro-Chemistry.

Radiant Chemical Action.

In the Examination for Honours, the Candidate, being not more than twenty-two years of age, who most distinguishes himself in Chemistry and Natural Philosophy, will receive an Exhibition of Forty pounds per annum for the next two years.

Second B.Sc. Examination.

This Examination commences on the fourth Monday in October. Candidates for this Examination who have not previously taken the degree of B.A. are required either to have passed the First B.Sc. Examination at least one Academical year previously, or to have passed the First M.B. Examination in this University.

The Fee for this Examination is £5.

This Examination embraces Organic Chemistry, including the following subjects :—

Ultimate Analysis of Organic Bodies. Calculation of Empirical Formulæ. Methods of controlling Empirical Formulæ. Determination of the Equivalents of organic acids and bases; examination of products of Decomposition; determination of the Vapour-Density of volatile bodies.

Law of Substitution. Compound Radicals. Homologous Series.

The Chemical History of the Cyanogen group. Cyanogen. Hydrocyanic Acid. Cyanic Acid and Urea. Fulminates. Cyanuric Acid. Sulphocyanic Acid. Chlorides of Cyanogen. Uric Acid.

Amylaceous and Saccharine Substances. Fermentation. Alcohol, Wine, Beer, Bread, &c.

Homologues of Alcohol. Ethers, simple and mixed. Oxidation of Alcohol. Aldehyd and Acetic Acid, and their homologues. Anhydrides, simple and mixed. Compound Ethers.

Diatomic Alcohols and their Acids. Glycol and Oxalic Acid and their homologues.

Triatomic Alcohols. Glycerin. Fatty and Oily bodies. Saponification.

Vegetable Acids;—the principal.

Ammonia and its Derivatives. Ammonium and Ammoniacal Salts. Amides and Amines: their Classification. The chief Natural Organic Bases.

Colouring Matters. Indigo and its derivatives. Principles of Dyeing.

The chief constituents of the Vegetable organism. Cellulose, Vegetable Fibrin, Albumen, Casein, Glutin, &c.

The chief constituents of the Animal organism. Animal Fibrin, Albumen, Casein, Gelatin. Blood, Milk, Bile, Urine, &c.

Decay, Putrefaction. Destructive Distillation.

The Chemical Principles of the process of Nutrition and of Respiration in Plants and Animals.

Examination for Honours.

The Candidate, not more than twenty-three years of age, who, in the Examination for Honours, most distinguishes himself in Chemistry, will receive Fifty pounds per annum for the next two years, with the style of University Scholar.

Doctor of Science (D.Sc.).

This Examination is held within the first twenty-one days of June, and occupies four days.

No Candidate is admitted to the Examination for the Degree of D.Sc. until after the expiration of two Academical years from the time of his obtaining the Degree of B.Sc. in this University.

Candidates for the Degree of D.Sc. in any year, must give notice of their intention to the Registar, and pay to him a Fee of Ten pounds, on or before the 1st of April.

Chemical Candidates can be examined either in Inorganic or Organic Chemistry; but no Candidate will be approved by the Examiners unless he has shown a thorough practical knowledge* of the *Principal Subject*, and a general acquaintance with the *Subsidiary Subject*, or *Subjects*, specified as belonging to the Branch so selected.

Inorganic Chemistry.

Principal Subject—Inorganic Chemistry.

Subsidiary Subjects—Either Organic Chemistry; or, Mineralogy, Crystallography, and Chemical Technology in its relations to Inorganic Chemistry.

Organic Chemistry.

Principal Subject—Organic Chemistry.

Subsidiary Subjects—Either Inorganic Chemistry; or, Chemical Technology, in its relations to Organic Chemistry, and the Chemistry of Animal and Vegetable Life.

The Examinations for Women.

The standard of attainment expected at the General Examination is the same as that expected in the corresponding subjects at the Matriculation Examination; and the standard of attainment expected at the Special Examinations is the same as that expected at those Examinations for the B.A. and B.Sc. Degrees, of which the programmes correspond.

* It must be understood that the Candidate for the Degree of D.Sc. is expected to be so fully conversant with the principal subject he may select, as to be able to go through any examinational test (whether theoretical or practical) of his acquirements in it that can be fairly applied.

In order that the requisite arrangements may be made, it is expected that intending Candidates will give notice of the optional subjects they select (where liberty of choice is allowed) not later than the 15th of March in each year.

General Examination.

The General Examination is held once in each year, and commences on the first Monday in May.

No Candidate is admitted to this Examination unless she has produced a Certificate showing that she has completed her seventeenth year. This Certificate must be transmitted to the Registrar at least *fourteen days* before the commencement of the Examination.

No Candidate is admitted to this Examination unless she has previously paid a Fee of Two Pounds to the Registrar. If a Candidate withdraw or fail to pass the Examination, the Fee is not returned to her, but she is admissible to any *two* subsequent General Examinations without the payment of any additional Fee, provided that she give notice to the Registrar at least *fourteen days* before the commencement of the Examination.

The Examination is conducted by means of printed papers; but the Examiners are not precluded from putting, for the purpose of ascertaining the competence of the Candidates to pass, *viva voce* questions to any Candidate in the subjects in which they are appointed to examine.

Candidates are not approved by the Examiners unless they have shown a competent knowledge in each of the following subjects:—

1. Latin, with Grammar, History, and Geography.
2. Any two of the following Languages:—Greek, French, German, Italian.
3. English Language, English History, and Geography (Physical and Topographical).
4. Mathematics.
5. Natural Philosophy.
6. Either Chemistry or Botany.

Certificates of Higher Proficiency.

Any Candidate who has passed the General Examination may be examined for a Special Certificate of Higher Proficiency in any one or more of the following subjects, either in the same year or in different years, provided that she give notice of her intention two calendar months before the commencement of the General Examination:—Latin, Greek, French, German, Italian, English, Mathematics and Mechanical Philosophy, Natural Philosophy and Chemistry, Botany, Human Physiology, Geology and Palæontology, Political Economy, Logic and Moral Philosophy, Harmony and Counterpoint.

The Examinations for these Certificates will commence on the day immediately following the third Monday in May.

CHEMICAL LECTURES AND LABORATORY INSTRUCTION.

UNIVERSITY COLLEGE.

FACULTY OF SCIENCE.

Dean.—Professor J. B. Sanderson, M.D., F.R.S.

Vice-Dean.—Professor A. W. Williamson, Ph.D., F.R.S.

The Session begins on Thursday, the 2nd of October, and ends about the end of June.

It is divided into three Terms, as follows:—Michaelmas term, from October 2nd until December 20th; Lent term, from January 7th, 1874, till March 18th; Summer term, for Lectures, from March 19th till June 9th, all inclusive.

Chemistry.—Professor Williamson, Ph.D., F.R.S.

Assistant Professor.—Charles Graham, D.Sc.

A. General Course.

Lectures daily, except Saturday, from 11 to 12 a.m., up to the last week in March.

Exercises on Tuesdays, Wednesdays, Thursdays, and Fridays, from 9 to 10 a.m.

Fee for the Whole Course of Lectures, £7 7s.; for the First or Second Half Course, separately £4 4s.; for the Second Half when the First has been taken, £3 3s.; Perpetual, £9 9s.; for the Organic Course alone, £2 2s.

Fee for the Exercise-Class—For the Course, £2 2s.; for the Half Course, £1 1s.

The Instruction in this Class is of two kinds, consisting partly of Experimental Lectures by the Professor, partly of exercises and personal instruction on the subject of the Lectures by the Assistant Professor.

Students cannot profit duly by attendance on the Lectures, unless they work at the subject of each Lecture so as to make it their own.

Attendance on the tutorial part of the Class enables Students to do their work more effectually and rapidly than they can do it by themselves.

The First Half of the Course to Christmas includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The Second Half of the Course, from January to March, includes the following subjects:—

Preparation and properties of the chief metals, including their charcteristic reactions and most important salts. Detection of Metallic Poisons. Quantitative Estimation of Metals. Principles of Classification. Monatomic, Diatomic Metals, &c.

A weekly *viva voce* examination is held during the First Half Course and the commencement of the second Half Course.

Organic Chemistry.

This commences in the second week in February, and occupies Five Lectures weekly till about the end of March. It includes a study of the characteristics and metamorphoses of the chief organic acids, bases, alcohols, ethers, colouring matters, &c. Methods of ultimate and proximate analysis. Determination of molecular weights. Theory of types; of compound radicals. Phenomena of fermentation, &c.

Teachers of Chemistry are trained in the theory and practice of their profession. A two years' Course is absolutely requisite for this purpose; but Students will with advantage devote a longer period to it.

The first year is occupied with attendance on the Courses of Chemistry and of Analytical Chemistry. In the second year the Student again attends the Course of Chemistry, and is entrusted with teaching work in conjunction with the tutors of the Class. At the same time he continues to work in the Laboratory at analysis and original research.

In order to qualify themselves for rising to the higher ranks of the Profession, gentlemen remain for a further period, in which case they may obtain remunerative work in teaching through the recommendation of the Professor.

It must not, however, be supposed that a study of Chemistry alone, however complete, is sufficient to qualify a man to teach the Science effectively. A competent knowledge of Physics, Mathematics, and either French or German must necessarily be acquired at some period of his Student's Course.

B. ANALYTICAL AND PRACTICAL CHEMISTRY.

I. BIRKBECK LABORATORY.

The instruction in the Laboratory is intended for beginners as well as for more advanced students. It includes practice in the construction and use of apparatus for preparing the common gases, acids, bases, salts, &c.; study of the qualitative methods of detecting and separating mineral or organic bodies from one another; also quantitative analysis in the wet way, organic analysis, vapour densities, &c.; instruction in gas analysis.

More advanced Students are instructed in the methods of original research, especially in organic chemistry.

When accompanied or preceded by attendance on the Lectures on Chemistry, the Laboratory Course qualifies Students in the application of Chemistry to the Manufacturing Arts, Metallurgy, Medicine, or Agriculture, &c. Instruction is given in the principles and processes of Gas Analysis.

The Laboratory and Offices are fitted up completely with the most improved apparatus and utensils for experimental research, both for beginners and for advanced Students. They are open daily, from 9 a.m. to 4 p.m., from the 4th of October until the end of July, with a short recess at Christmas and at Easter. Saturday, from 9 to 2.

Fees for the Session, 25 guineas; six months, 18 guineas; three months, 10 guineas; one month, 4 guineas; exclusive of the expense of materials. A deduction of about 40 per cent is made for Students who can attend only three fixed days per week.

A Gold Medal and Certificates of Honour are competed for by Students entered for the Session.

II. SUMMER COURSES.

I. *Elementary Course.*

About Forty Lessons, of one hour each, on Tuesday, Wednesday, Thursday, and Friday, from 11 to 12, commencing in the first week of May. Students are taught the construction and use of apparatus for the preparation of the most important gases, acids, &c. The characteristic tests for the presence of the common acids and bases, including the chief metallic and other poisons. Also the processes for separating these bodies from one another.

Solutions are frequently given in the class for investigation.

The first six weeks of the Course are occupied by the study of the chief non-metallic elements, and their simple compounds. Metallic salts, &c., are subsequently studied.

Fee, including the cost of materials and apparatus, for the Course, £4 4s.; Perpetual, £7 7s.

II. *Senior Course.*

This Course consists of Twenty Lessons, of two hours each, on Mondays and Saturdays, from 10 to 12, commencing in the first week in May.

The First Half of the Course includes tests for fixed and volatile organic acids, nitrogenised acids, sugars, glycerin, alkaloids, &c.

The Second Half of the Course includes tests for mineral poisons in organic mixtures; also tests for organic bodies, such as the alkaloids, when mixed with other organic substances.

Volumetric methods of the quantitative analysis of sugar and urea, chlorides, phosphates, hardness of water, alkalimetry, are practised.

Analyses of milk and of ashes of blood.

Fee, including cost of materials and apparatus, for the Course, £4 4s.; Perpetual, £7 7s.

C. SUMMER MATRICULATION COURSE.

Professor Williamson, F.R.S.

Assistant Professor.—Charles Graham, D.Sc.

This Course includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The Course consists of about Twenty Lessons in Practical Chemistry, and of an equal number of Oral Lessons. The Practical Lessons include the preparation of the common gases and acids, &c., and the study of their characteristic properties in relation to the elementary laws of combination.

The other Lessons are chiefly devoted to those parts of the subject which require fuller oral explanation than is given in the Practical Lessons. They include numerous exercises and questions, to which answers in writing are given by the Students. These Lessons will begin on Tuesday, April 14, 1874, at 11 a.m.

The Class will meet on Tuesdays, Wednesdays, Thursdays, and Fridays, from 11 to 12; and some other meetings will be announced when the Class has assembled.

Fee, including cost of materials and apparatus, £4 4s.

SCIENCE AND ART DEPARTMENT OF THE COMMITTEE OF COUNCIL ON EDUCATION, SOUTH KENSINGTON,

AND

ROYAL SCHOOL OF MINES, JERMYN STREET.

The Lords of the Committee of Council on Education having transferred the instruction in Physics, Chemistry, Applied Mechanics, and Natural History, from the Royal School of Mines, in Jermyn Street, and the College of Chemistry, in Oxford Street, to the New Buildings, in Exhibition Road, South Kensington, the following Courses of Lectures, Demonstrations, and Practical Laboratory instruction are now given at South Kensington at the dates specified :—

Chemistry, by Professor Frankland, D.C.L., F.R.S. A Course of Forty Lectures on Inorganic Chemistry, commencing October 6, 1873. A Course of Thirty Lectures on Organic Chemistry, commencing January 19, 1874. Laboratory instruction, consisting of an elementary and an advanced Course, commencing on October 1. Fees—Lectures on Inorganic Chemistry, £4 ; Lectures on Organic Chemistry, £3 ; together, £6. Laboratory instruction—£12 for three months, £9 for two months, and £5 for one month.

Biology, by Professor Huxley, LL.D., F.R.S. A Course of Eighty Lectures on Biology (or Natural History, including Palæontology), with Laboratory instruction, commencing October 6, 1873. Fee for the full Course, £10—For the Lectures only, £4 ; for the Laboratory instruction, £6.

Physics, by Professor Frederick Guthrie. The Course will consist of about Sixty Lectures, with Laboratory work on the subject of the Lectures. The Course will commence on February 16, 1874. Fee for Lectures alone, £4 ; fee for Lectures and Laboratory work, £10.

Applied Mechanics, by Professor Goodeve, M.A. The Course will consist of Thirty-Six Lectures, with Demonstrations, commencing on February 16, 1874. Fee for the Course, £4.

Besides the Students entering for the Associateship of the Royal School of Mines, and Teachers in Training, only such a limited number of occasional public Students will be admitted as can be accommodated. Letters with respect to the foregoing Courses should be addressed to the Secretary, Science and Art Department, South Kensington, London, S.W.

The instruction in Chemical Science embraces :—

(1). A Course of Lectures on Experimental Chemistry, with special reference to the applications of Chemistry in the Arts and Manufactures.

(2). A systematic Laboratory Course for the Practice of Chemical Analysis.

(3). An advanced Laboratory Course for technical applications of Chemical Analysis and for Chemical Research.

Chemical Laboratories.—The Laboratories for instruction in chemical manipulation, in qualitative and quantitative analysis, the technical application of analysis, and in the method of performing chemical researches, are under the direction of Dr. Frankland, and will be opened on Wednesday, October 1, 1873. The Laboratories at South Kensington Museum are now used for the instruction of the pupils of the Royal School of Mines.

There are three terms in the collegiate year, of three months each, commencing in the first week of October, January, and April, respectively. The Laboratory hours are from 10 a.m. to 5 p.m., with the exception of Saturdays, when the Laboratory closes at 2 o'clock.

Each Laboratory Student works independently, there being no classes. All operations are superintended by the Professor and his assistants. A table with drawers, cupboards, and shelves is appropriated to every pupil. The Institution supplies gas, fuel, and reagents. The larger and more expensive instruments of the Laboratory, such as air-pumps, thermometers, barometers, condensers &c., may be used by the Students, who are responsible for their safety. The Students have to provide themselves only with the apparatus specified in the Laboratory regulations. More advanced Students engaged in private researches have to supply themselves with such materials as are not included amongst the ordinary reagents of the Laboratory.

The charge for instruction in the Chemical Laboratory is £12 for three months, £9 for two months, and £5 for one month. This charge does not include the fees for attending the Lectures.

Professor of Metallurgy.—Dr. Percy, F.R.S.

The course of instruction in Metallurgy consists of Lectures and Laboratory Practice, especially in Assaying.

The object of the Lectures is the communication of such instruction as the student may be able to apply to the greatest practical advantage when he may be subsequently engaged in conducting any metallurgical process.

Metallurgical Laboratory.—This Laboratory is conducted by Mr. R. Smith, under the direction of Dr. Percy, and is devoted to practical instruction in Metallurgy, especially in Assaying. The nature of this instruction will be adapted to the special requirements of the student. It comprises :—Assaying in all its branches, especially of the more important metals, such as iron, copper, lead, tin, alloys of silver and gold, &c. ; and the examination of ores and metallurgical products.

The ability of the student to make trustworthy assays is in every case thoroughly tested ; and no certificate of competency is given to a student who has not furnished satisfactory proof that he is able to obtain accurate results.

There are three terms in the collegiate year, of three months each. The Laboratory hours are from 10 to 4 during November, December, January, February ; and from 10 to 5 during the other months, with the exception of Saturdays, when the Laboratory is closed.

The charge for instruction in the Metallurgical Laboratory is £15 for three months, £12 for two months, and £7 for one month.

Lectures to Working Men.—Short Courses of Lectures at suitable periods of the year are given in the evening to Working Men. These courses are systematic, and arranged so as to illustrate, within a period of two years, the principal subjects taught at the Institution. Those for the ensuing Session include Natural History, Geology, and Mineralogy.

EXAMINATIONS IN CONNECTION WITH THE DEPARTMENT OF SCIENCE AND ART, SOUTH KENSINGTON.

A sum of money is voted annually by Parliament for scientific instruction in the United Kingdom. The object of the grant being to promote instruction in Science, especially among the Industrial classes, by affording a limited and partial aid or stimulus towards the founding and maintenance of Science schools and classes.

The following are among the Sciences towards instruction in which aid is given :—Acoustics, Light, Heat, Magnetism, and Electricity, Inorganic Chemistry, Organic Chemistry, Geology, Mineralogy, Mining, Metallurgy.

The assistance granted by the Science and Art Department is in the form of—1. Public Examinations, in which Queen's Medals and Queen's Prizes are awarded, held at all places on complying with certain conditions. 2. Payments on results to teachers. 3. Scholarships and Exhibitions. 4. Building Grants. 5. Grants towards the purchase of apparatus, &c.

KING'S COLLEGE.

Professor of Chemistry and Practical Chemistry.—C. L. Bloxam, F.C.S.

Demonstrator.—W. N. Hartley, F.C.S.

The Session commences on the 1st of October. Students of the first and second years are admitted to the Course of Theoretical and Applied Chemistry. The Course commences with a view of the forces which concur to

the production of Chemical Phenomena, after which the laws of Chemical Attraction are discussed, and the Non-Metallic Elements and their principal compounds are described.

The metals and their principal compounds are next examined, care being taken to point out the applications of the Science to the Arts, and the processes of the different Manufactures of Metallurgy, and of Domestic Economy, are explained and illustrated.

Examinations of the Class, both *viva voce* and by written papers, are held at intervals during the Course, at the usual Lecture hour.

Third Year.—Students who have completed six Terms in this Department are admitted to a Course of Practical Chemistry, consisting of Twelve Demonstrations in each term; and they go through a course of Manipulation in the most important operations of Chemistry, including the first steps of Analysis.

Any Student of this Department may be admitted to this Class at any period of his study, on payment of an extra fee.

Analytical and Experimental Chemistry.—Besides the Course of Chemical Lectures and the Summer Class of Practical Chemistry, provision is made for those Students who wish to become more minutely acquainted with the practical details of the Science. By means of this Class each Student is enabled to familiarise himself with the methods of analysis and research. After passing through a preliminary course of analytical operations, each Student devotes himself to such portions of the science as are most interesting to himself, or most likely to be practically useful to him. The Daniel Scholarship of £20, tenable for two years, is given every alternate year for original research in the Laboratory.

The Fees for admission to the Laboratory Class, exclusive of materials, are, for one month, £4 4s.; for three months, £10 10s.; for six months, £18 18s., &c.

EVENING CLASSES.

Classes for Evening Instruction are held at King's College from October to March, and during April, May, and June.

The Classes include one for the Elements of Chemistry and one for Practical Chemistry.

The fee for the former is £1 11s. 6d.; for the latter, £2 2s. The classes meet twice a week.

THE SCHOOL OF PHARMACY,
17, BLOOMSBURY SQUARE, W.C.
(IN CONNECTION WITH THE PHARMACEUTICAL SOCIETY.)

The Session commences on October 1st, and extends to the end of July.

LECTURES ON CHEMISTRY AND PHARMACY, BY DR. REDWOOD.

These Lectures will be delivered on Monday, Tuesday, and Wedneday mornings, at 9 o'clock.

Fees.—One Course, £2 2s. An entire Session—two Courses, £3 3s. Perpetual admission, £4 4s.

Also Lectures on Botany and Materia Medica, by Professor Bentley. The first and second parts of this course, extending over the winter months, will be delivered at 17, Bloomsbury Square, on Friday and Saturday mornings, at 9 a.m. The third part of the course, on Systematic Botany, will be delivered at the Royal Botanic Gardens, Regent's Park, at 8 a.m.

Fees.—Botany and Materia Medica, one Course, £1 11s. 6d.; two Courses, £2 12s. 6d. Systematic and Practical Botany, £1 1s. each Course. Sessional Fee for the three Courses, £3 3s.

Practical Chemistry.—The suite of Laboratories for Practical Instruction in General and Pharmaceutical Chemistry will be opened on October 1st, under the direction of Professor Attfield, Ph.D.

Demonstrator.—John Moss, F.C.S. Fee for the entire Session of ten months, Twenty-five Guineas. The Laboratories are open from 10 a.m. till 5 p.m. Students can enter at any period during the Session.

Two Scholarships (the Jacob Bell Memorial Scholarship) of Thirty Pounds a year each, are open to competition annually in July.

Students have free admission to the Library and Museum.

CITY OF LONDON COLLEGE, LEADENHALL STREET, E.C.

The Annual Courses consist of three terms, each averaging ten Experimental Lectures. Fee, 5s. per term.

Subjects:—Junior Class, Chemistry—First year, Non-Metals; second year, Metals and (time permitting) Elements of Organic Chemistry. Senior Class, 7 to 8 p.m., Practical Analysis.

BIRKBECK LITERARY AND SCIENTIFIC INSTITUTION,

EVENING CLASSES.

Chemistry, Elementary.—Mr. G. Chaloner. Thirty Lectures. Tuesday, 7.30 to 8.30, commencing October 7.

Advanced.—Tuesday, 9 to 10. Thirty Lectures.

Practical Chemistry and Analysis.—From 8 to 10, Saturday evenings, commencing October 11.

ROYAL POLYTECHNIC INSTITUTION,
309, REGENT STREET, W.

The Scientific Department is under the direction of Professor E. V. Gardner, F.A.S., F.S.A., who is assisted in his duties by gentlemen of known competency.

Instruction in classes is given in Chemistry, Electricity, Galvanism, Geology, Photography, &c. These and the various subjects required by the different Examining Boards are taught and thoroughly demonstrated. To this purpose the extensive School of Apparatus, as well as that employed for illustrating the Public Lectures, is made use of.

Private Courses of study can also be pursued under the direction of Professor Gardner, who has constructed Private Class Rooms and Laboratories.

Provision has been made for Ladies desirous of studying the Sciences.

The Patent Department is valuable to Inventors, as they can be provided with the necessary apparatus to pursue their enquiries, or they may have a full investigation conducted.

ROYAL VETERINARY COLLEGE, CAMDEN TOWN.

Chemical Professor.—Mr. R. V. Tuson.

BERNERS COLLEGE OF EXPERIMENTAL SCIENCE,
44, BERNERS STREET, W.

Under the direction of Professor E. V. Gardner, F.A.S. F.S.A.

The Class Rooms and Laboratories are open to private students, who can arrange to pursue any branch of study at their own convenience with the advantage of School of Apparatus for illustration and experiment.

The Classes during the Session embrace the subjects of Chemistry, Magnetism, Electricity, Galvanism, Geology, Photography, Botany, Steam, &c.

A Course of study is arranged to meet the requirements of gentlemen preparing for Matriculation, for the various Governmental Examinations and Examining Boards.

Analysis of manures and other substances and Assays are performed, and much attention is paid to original experiments and investigations connected with Patents and Inventions.

Mathematics.—The Classics, Modern Languages, and the branches of knowledge usual for a successful examination are in the hands of competent teachers.

NORTH LONDON SCHOOL OF CHEMISTRY AND PHARMACY,
54, KENTISH TOWN ROAD, N.W.

Conducted by Mr. J. C. Braithwaite.

The Session 1873-1874 commences on the 1st of

October, when the Laboratory will be open for Instruction in Practical Chemistry.

The Classes for Chemistry, Materia Medica, Botany, and Latin, meet at 8 p.m. Fee to either Class 10s. 6d. per month.

The Botanical Garden affords facilities to Students desirous of acquiring a practical knowledge of Botany. During the Season Botanical Excursions are made every Saturday at 10 a.m.

As each Pupil works independently, he can enter at any period to either Classes or Laboratory.

SOUTH LONDON SCHOOL OF CHEMISTRY, 325, Kennington Road.

This School was re-opened on September 8th in a new building specially erected for and adapted to the study of Chemistry and its Allied Sciences. The subjects taught include Chemistry, Botany, Physics, Latin, Materia Medica, and Pharmacy, for fifty students. All apparatus and chemicals are provided for the students. There is also a special department for instruction in Food Analysis at the Central Public Laboratory, Kennington Cross, under the personal supervision of the Director, who has been appointed Public Analyst. The Chemical portion of the Course consists of Ten Months' Lectures on Inorganic and Organic Chemistry. The Lecturer is Dr. John Muter, F.C.S., and the hour is 10 a.m. daily. The Laboratory is open daily for practical instruction from 10 till 4. Secretary, Mr. W. Baxter.

LECTURES AT LONDON MEDICAL SCHOOLS.

ST. BARTHOLOMEW'S HOSPITAL & MEDICAL COLLEGE.

WINTER SESSION.

Lecturer.—Dr. W. J. Russell, F.R.S. Monday, Wednesday, and Friday, at 10 a.m. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. W. J. Russell, F.R.S. Monday, Tuesday, and Friday, from 11 to 1. One course, £2 2s.

CHARING CROSS HOSPITAL AND COLLEGE.

WINTER SESSION.

Lecturer.—Mr. C. W. Heaton, F.C.S. *Demonstrator.*—T. Bolas, F.C.S. Monday, Thursday, and Friday, at 11. One session, £5 5s.

The Laboratory is open daily.

SUMMER SESSION.

Practical Chemistry.—Mr. Heaton, F.C.S. *Demonstrator.*—T. Bolas, F.C.S. Monday and Friday. One session, £2 2s.

Special Evening Classes. Advanced Chemistry, Tuesday and Thursday, at 7 p.m. Fee, £2 2s. per month.

ST. GEORGE'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. H. M. Noad, F.R.S. Tuesday, Thursday, and Saturday, at 11.30. One course, £6 6s.

SUMMER SESSION.

Practical Chemistry.—Dr. Noad, F.R.S., Monday, Wednesday, Thursday, Friday, at 10. One course, including the use of apparatus and materials, £4 4s.

GUY'S HOSPITAL.

WINTER SESSION.

Lecturers.—Dr. Debus, F.R.S., and Dr. Stevenson. Tuesday, Thursday, and Saturday, at 11. One course, £4 4s.

SUMMER SESSION.

Practical Chemistry.—Dr. Debus, F.R.S. Monday, Wednesday, and Friday, from 10 to 1. One course, £4 4s.

Practical Instruction is also given in the Laboratory by Drs. Debus and Stevenson during the Winter Session.

LONDON HOSPITAL.

Lectures on Chemistry.—Henry Letheby, M.B., and C. Meymott Tidy, M.B. Monday, Wednesday, and Friday, at 10.30 a.m. One session, £7 7s.

Practical Chemistry.—Dr. Letheby, M.B. Monday, Thursday, and Saturday, at 9 a.m. One session, £3 3s.

ST. MARY'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. C. R. A. Wright, F.C.S. Monday, Tuesday, Thursday, and Friday, at 9 a.m. £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. C. R. A. Wright, F.C.S.

Inorganic Course.—Arranged for the requirements of the London University Preliminary Scientific Examination. Tuesday, Friday, and Saturday, at 9 a.m. Fee, £3 3s.

Organic Course.—Arranged to meet the requirements of the London University First M.B. Examination. Tuesday and Friday at 10 a.m. £3 3s.

MIDDLESEX HOSPITAL.

WINTER SESSION.

Lecturer.—Mr. Heisch. Monday, Tuesday, Friday, and Saturday, at 11. One session, £6 6s.

SUMMER SESSION.

Practical Chemistry.—Mr. Heisch. Monday, Wednesday, and Friday, at 11. One session, £3 3s.

ST. THOMAS'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. J. Bernays. Wednesday, Thursday, and Friday, at 9. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. A. J. Bernays. Tuesday and Thursday, 10 to 12; Friday, 11; Saturday, 10 to 1. One course, £3 3s.

WESTMINSTER HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. Dupré, F.C.S. Tuesday and Thursday, at 3 p.m.; Friday, at 10 a.m. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. A. Dupré, F.C.S. Monday, Wednesday, and Friday, at 10 a.m. One course, £3 3s.

TEACHERS OF CHEMISTRY IN LONDON.

Mr. Henry Matthews, F.C.S.—Laboratory, 60, Gower Street, Bedford Square. Instruction in all branches of Practical Chemistry, particularly in its application to Medicine, Agriculture, and Commerce. Laboratory open daily, except Saturday, from 10 to 5; on Saturday, from 10 to 1.

Mr. John Newlands, F.C.S.—Laboratory, 13, Knowle Road, Brixton, S.W. Gives practical instruction in Analysis, and prepares gentlemen for various public examinations.

Mr. A. Vacher.—20, Great Marlborough Street, Regent Street.

UNIVERSITY OF OXFORD.

Professor of Chemistry.—Dr. Odling, F.R.S.

Demonstrator.—E. Madan, M.A.

A commodious Laboratory is attached to the New Museum.

Scholarships of about the value of £75 are obtainable at Christ Church, Magdalen, and other Colleges, by competitive examination in Natural Science.

UNIVERSITY OF CAMBRIDGE.

Professor of Chemistry.—G. D. Liveing, M.A.

Demonstrator.—J. W. Hicks, M.A.

LECTURES IN MICHAELMAS TERM.

Chemistry, general principles, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.

Spectroscopic Analysis, by the Professor.
Practical Chemistry, by the Demonstrator, daily.
Organic Chemistry, by Mr. Main, at St. John's College.
Volumetric Analysis, by Mr. Apjohn, at Gonville and Caius College.

LECTURES IN LENT TERM.

Chemistry, general principles continued, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.
Quantitative Analysis, by the Professor, same days, at 1.
Practical Chemistry, by the Demonstrator, daily.
Elementary Chemistry, by Mr. Main, at St. John's College.
Quantitative Analysis of rarer elements, by Mr. Apjohn, at Gonville and Caius College.

LECTURES IN EASTER TERM.

History of Chemical Philosophy, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.
Quantitative Analysis, same days, at 3.
Elementary Inorganic Chemistry, by the Demonstrator.
Chemistry, continued, by Mr. Main, at St. John's College.
Organic Analysis, by Mr. Apjohn, Gonville and Caius College.
The Chemical Laboratory of the University is open daily from 10 a.m. until 6 p.m., for the use of students, under the direction of the Professor. The Demonstrator attends there daily to give instruction in manipulation, alternately in the morning and afternoon.

PROVINCIAL SCHOOLS.

BIRMINGHAM.—MIDLAND INSTITUTE.

Lecturer on Chemistry.—Mr. C. J. Woodward, B.Sc. Tuesday and Thursday, at 8 p.m.
Practical Chemistry.—Mr. C. J. Woodward, B.Sc. Saturday, 3 to 6, and 6.30 to 9.30 p.m.

BIRMINGHAM.—QUEEN'S COLLEGE.

WINTER SESSION.

Professor of Chemistry.—Alfred Hill, M.D., and A. G. Anderson. Tuesday, Thursday, and Friday, at 12.

SUMMER SESSION.

Practical Chemistry.—Professor A. G. Anderson. Thursday and Friday, at 2 p.m.

BRISTOL.—BRISTOL MEDICAL SCHOOL.

WINTER SESSION.

Lecturer.—Mr. Thomas Coomber, F.C.S. Monday, Tuesday, Wednesday, and Thursday, at 8.15. One Course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Mr. T. Coomber, F.C.S. Daily, except Saturday, at 8 a.m. One Course, £3 3s.

ROYAL AGRICULTURAL COLLEGE, CIRENCESTER.

CHEMICAL DEPARTMENT.

Professor.—A. H. Church, M.A. Oxon.
Assistant.—R. C. Woodcock, F.C.S.

The Autumn Session commenced on the 13th of August; it divides on the 6th of October, and terminates about the 18th of December.

The Chemical instruction comprises Three Courses of Lectures and Laboratory Practice:—

(1). 32 Lectures on Inorganic Chemistry.
(2). 32 Lectures on Organic Chemistry.
(3). 24 Lectures on Agricultural Chemistry.
(4). 32 Lessons on Chemical Manipulation.
(5). 32 Lessons on Qualitative Analysis.
(6). 32 (or more) Lessons on Quantitative Analysis.

Catechetical Lectures are also given, while analyses of manures, oil-cakes, minerals. soils, waters, &c., are daily performed in the College Laboratories, and Chemico-Agricultural researches undertaken by the more advanced Students, under the immediate direction of Professor Church.

The text-books used are Church's "Laboratory Guide," Roscoe's "Chemistry," and Church and Dyer's edition of "How Crops Grow."

LIVERPOOL ROYAL INFIRMARY SCHOOL OF MEDICINE.

Lecturer on Chemistry and Toxicology.—Dr. J. Campbell Brown.

Course of 100 Lectures. Monday, Tuesday, Thursday, and Friday, at 10.15. £5 5s.

Technological and other non-Medical Students may take out any of the divisions separately—Fee, £1 1s.; but no certificates will be given until the whole Course has been attended.

Practical Chemistry.—The new Laboratories will be open on November 1 for the reception of Students, when those who desire to prosecute Practical Chemistry, analysis, or original research, will be provided each with a separate working bench and cupboard, with tests, fuel, water, and gas. Fees, from £2 2s. to £10 10s. per quarter.

Summer Practical Chemistry Course.—Fee, £3 3s.

A Class for the Practical study of Organic Chemistry will be formed during either the Winter or Summer Session. Fee, £3 3s., including materials and apparatus.

Gentlemen who are not Students of the School are also admitted to the Laboratory and Lectures.

The Laboratory is open daily from 10 to 4 (except Saturday), for the study of Practical Chemistry, and for Analysis.

ANALYTICAL LABORATORY AND SCHOOL OF TECHNICAL CHEMISTRY.

7 and 9, HACKIN'S HEY, LIVERPOOL.

Conducted by Mr. A. Norman Tate.

Hours of attendance, 9.30 a.m. to 5 p.m. (Saturdays, 9.30 a.m. to 1 p.m.). Pupils may enter at any time and for any term.

Fees—Three months, £15 15s.; six months, £26 6s.; twelve months, £52 10s.

The Laboratory is also open from October to end of April two evenings per week for practical work.

Lectures one evening each week.

A separate working bench is provided for each Student, and he is also supplied with all ordinary chemicals, gas, fuel, and the more substantial portions of Laboratory apparatus, but must provide himself with test-tubes, beakers, and other apparatus of a fragile nature.

In addition to the ordinary chemical studies, the Course of instruction will, as far as possible, comprise all such studies as may be required for the successful prosecution of the particular branch or branches of Applied Chemistry in which the pupil is to engage; as, for example, in the case of one intended for manufacturing pursuits, he would study architectural and mechanical drawing, so far as is required for the preparation of plans, &c., of chemical apparatus and manufactories, the nature and use of building materials, and the scientific principles and practical rules involved in building and constructive operations, and other scientific and practical information required in the arrangement, construction, and management of chemical manufactories, and the application of Chemistry to industrial pursuits.

LIVERPOOL.—OPERATIVES' SCIENCE CLASSES.

(IN CONNECTION WITH THE GOVERNMENT DEPARTMENT OF SCIENCE AND ART, AND THE OPERATIVE TRADES' HALL, LIVERPOOL).

Chairman.—Mr. James Samuelson.
Secretary.—Mr. M. Fitzpatrick, 62, Seel Street.

Session extends from October 3, 1873, to end of April, 1874.

Classes meeting at 9, Hackin's Hey—Lecture Class, Friday evenings, 7 to 8 p.m.; Laboratory Practice, Friday evenings, 8 to 10 p.m. Teacher, Mr. Norman Tate.

Class meeting at St. Mary's Schools, Kirkdale—Lecture Class, Thursday evenings. Teacher, Mr. Gordon.

COLLEGE OF CHEMISTRY, LIVERPOOL.

Founder.—Dr. Muspratt, M.D., &c.

Principal.—Mr. Martin Murphy, F.C.S., Professor of Chemistry.

The Course of instruction given in the College of Chemistry comprises the teaching of Chemistry as a science, and the general application of chemical knowledge; also the teaching of the principles of those branches of physics which are allied with Chemistry, such as light, heat, electricity, &c.

Particular attention is devoted to instruction in the practice of systematic analytical operations, whereby Students will be enabled to determine accurately the general and proximate constituents of substances, and so arrive at a knowledge of their nature and properties.

Instruction in the application of chemical data to medicine and agriculture, and to the chemical and metallurgical operations, comprising Technology, will be given, to qualify Students for these avocations.

The Students will invariably be controlled and directed in their study and work by the Principal and competent assistants. Ample Laboratory accommodation is provided for Students, and such general appliances as will facilitate their progress in acquiring a knowledge of the specialities taught in the College.

The Students' Laboratories are open throughout the year. Hours of attendance—From 10 a.m. to 5 p.m. daily. Fees—10 guineas per quarter of three months, or 35 guineas per annum, payable in advance. Students provide all their own apparatus and books.

Medical and Pharmaceutical Students are admitted for one hour per day. Fee for three months, £2 2s.

A Course of Lectures will be delivered to the Students during the winter months. Evening Classes.

Certificates of attendance recognised by the University and Apothecaries' Hall of London, and Apothecaries' Hall of Ireland.

LEEDS SCHOOL OF MEDICINE.

WINTER SESSION.

Lecturer.—Mr. Thomas Fairley, F.C.S.

Daily, except Wednesday and Saturday, at 11 a.m. First Session, £4 4s. Second Session, £3 3s.

SUMMER SESSION.

Practical Chemistry.—Mr. Fairley, F.C.S.

Mondays and Tuesdays, 9.30 to 11. Each Course, £3 3s.

General Chemical Students.—The Laboratories are open daily, under the direction of Mr. Fairley, for the instruction of General Students in Chemical Manipulation, Technical Chemistry, and all branches of analysis; and also for the use of gentlemen wishing to pursue special chemical researches.

The fees, payable in advance to the Treasurer, are as follows:—For one month, £4 4s.; for two months, £7 7s.; for three months, £10 10s.; for four months, £13 13s.; for five months, £15 15s.; for six months, £17 17s.; for nine months, £21. Special fees will be charged to Students who do not wish to work every day in the week.

The Chemical Museum contains minerals, metallic ores and metals, rare chemical substances, and illustrations of the most important chemical manufactures in their different stages.

Curator.—Mr. Scattergood.

LEEDS MECHANICS' INSTITUTION AND LITERARY SOCIETY'S LABORATORY.

Chemical Classes and Laboratory for Instruction in Elementary, Practical, and Analytical Chemistry, commence on Friday, September 26, at 8 p.m.

Lecturer.—Mr. George Ward, F.C.S., with Assistants.

HIGH HARROGATE COLLEGE, YORKSHIRE.

Professor of Chemistry.—Mr. W. G. Mason, F.C.S., Certificated Science Teacher.

MANCHESTER GRAMMAR SCHOOL.

CHEMICAL DEPARTMENT.

Professor.—Francis Jones.

Instruction is given in Inorganic Chemistry, Organic Chemistry, Metallurgy, and Analytical Chemistry. There is a lecture-room and second Laboratory, affording accommodation for seventy-two Students.

MANCHESTER ROYAL SCHOOL OF MEDICINE.

(INCORPORATED WITH OWENS COLLEGE).

Lecturer on Chemistry and Practical Chemistry.—Henry E. Roscoe, B.A., Ph.D., F.R.S.

The usual Course for the Medical Boards.

Pending the completion of Medical School Buildings, in immediate proximity to the new College, the School will be conducted as heretofore in the old premises, 10, Faulkner Street, with the exception of the following Courses, which will be given in the Owens College, Oxford Road:—Chemistry and Physiology, Systematic and Practical, in the Winter Session, and Botany and Practical Chemistry in the Summer Session.

OWEN'S COLLEGE, MANCHESTER.

Chemistry.—Professor H. E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

Senior Demonstrator.—Mr. C. Schorlemmer, F.R.S.

Junior Demonstrator and Assistant Lecturer.—Mr. W. Dittmar, F.R.S.E.

Assistant Demonstrators.—Mr. W. Carleton Williams and Mr. Harry Grimshaw.

Experimental Chemistry Lectures.—Monday, Tuesday, Wednesday, Thursday, and Friday, from 11.30 a.m. to 12.30 p.m., during Michaelmas and Lent Terms.

The instruction in Theoretical Chemistry is given by means (*a*) of Experimental Lectures and (*b*) of Tutorial classes. The former will be delivered by Professor Roscoe on the days above-named.

Inorganic Chemistry.—Comprising (1) the laws of Chemical Combination; (2) A description of the Physical and Chemical properties, and the mode of preparation of the Non-Metallic Elements and of their compounds; (3). The Chemistry of the Metals and of their most important compounds.

Organic Chemistry.—Giving the composition and relations of the best defined groups of organic bodies and the laws regulating their formation.

The Tutorial Classes, conducted by Mr. Dittmar, will meet for recapitulation and for the correction of the written exercises, given out in the lectures during Michaelmas and Lent Terms, as follows:—1. *Junior Tutorial.* For First Year's students and those preparing for Matriculation, on Wednesdays, from 1·30 to 2·30 p.m. 2. *Senior Tutorial.* For Second Year's students and those preparing for the Science Degrees, on Saturdays, from 11·30 a.m. to 12·30 p.m. 3. *Medical Tutorial.* Specially adapted to the requirements of Medical students, on Fridays, from 12·30 to 1·30 p.m.

Regular students in the First Year's Arts and Science courses will be entitled to attend during the Michaelmas Term only, in the Second Year's Science and Engineering courses during both Terms.

Fee, for the complete course, £4 14s. 6d.; for either half, £2 12s. 6d.

Technological Chemistry.—Wednesday, from 2.30 to 3.30 p.m.

The chemical principles involved in the most important Chemical Manufactures will chiefly be considered in this course. The subject will be discussed as follows:—

1. Ten lectures on the Modes of Producing and Utilising Heat and Light, by Mr. Dittmar.

2. Ten lectures on Water and Air and the Chemistry of the Alkali Manufacture, by Professor Roscoe.

3. Ten lectures on the Chemistry of Colouring Matter, Dyeing, and Calico Printing, by Mr. Schorlemmer.

Students attending this class must be acquainted with the principles of chemical science.

Fee, £1 11s. 6d.

Organic Chemistry.—Lecturer, Mr. C. Schorlemmer, F.R.S., Tuesday and Thursday, from 2.30 to 3.30 p.m., and Friday, from 3.30 to 4.30 p.m.

The subject of this course is the Chemistry of the Carbon Compounds, wherein the branch of Organic Chemistry is more fully and completely treated than in the general course in Experimental Chemistry.

Fee, £3 10s.

Chemical Philosophy.—Lecturer, Mr. C. Schorlemmer, F.R.S., Saturday, from 9.30 to 10.30 a.m.

Sketch of the History of Chemistry; Development of Modern Chemistry; Chemical Laws and Theories; Relation of Chemistry to Physics.

Fee, £1 11s. 6d.

Lecture Classon Analytical Chemistry.—Mr. W. Dittmar, F.R.S.E. Tuesday, from 4.30 to 5.30 p.m.

This course will treat of the methods of Qualitative and Quantitative Analysis, and is intended to supplement the instruction in Practical Chemistry.

All first year's Laboratory students are required to attend, and to answer the written exercises and the *viva voce* questions given in this class.

Fee, £1 11s. 6d.

Analytical and Practical Chemistry.

LABORATORY CLASS.

The aim of this course is to make the student practically acquainted with chemical science, to enable him to conduct analysis and original research, and to fit him for applying the science to the higher branches of Art, Manufactures, and Agriculture. To accomplish this, an attendance of not less than four days per week during three whole sessions is as a rule necessary. It is very advisable that each Laboratory student should attend, or should have attended, the course of Lectures on Theoretical Chemistry; and it is also recommended that second year's Laboratory students should attend one of the classes in Practical Physics.

The College Laboratory will be open for students daily from 9.30 a.m. until 4.30 p.m., except on Saturdays, when it will be closed at 12.30. The Laboratory is fitted with every convenience for the prosecution of Practical Chemistry, all branches of Qualitative and Quantitative Analysis, and original Research. Each student is provided with a separate working table, a set of tests, fuel, water, and gas, free of expense; but he is required to find his own apparatus, a few of the more expensive reagents, and the chemicals required for his experiments. Other apparatus or instruments of a more expensive description may be obtained on loan from the Laboratory Steward, subject to regulations to be prescribed by the Professor.

Fees for the Session.—For six days per week, £21; for four days per week, £17 17s.; for three days per week, £13 13s.; for two days per week, £9 9s.; for one day per week, £5 5s.

Students entering the Laboratory class at or after Christmas will be charged two-thirds of the fees for the whole session.

Fees for Shorter Periods.—For six days per week: For six months, £17 17s.; for five months, £15 15s.; for four months, £13 13s.; for three months, £10 10s.; for two months, £7 7s.; for one month, £4 4s.

The Lectures on Chemistry in Owen's College are recognised by the University of London for its Medical Degrees, by the Royal College of Surgeons, and by the Apothecaries' Hall.

EVENING CLASSES.

Chemistry.

First Lecture Course.—(The Non-Metallic Elements).—Professor Roscoe. Monday, from 8.30 to 9.35 p.m.

Second Lecture Course.—(The Metals).—Mr. Carnelly. Friday, from 8.35 to 9.35 p.m.

Third Lecture Course.—(Organic Chemistry).—Mr. Schorlemmer. Thursday, from 8.35 to 9.35 p.m.

Laboratory Courses.—Professor Roscoe and Mr. Dittmar. Monday, from 6 to 8.30 p.m.

COLLEGE OF PHYSICAL SCIENCE, NEWCASTLE.

(IN CONNECTION WITH THE UNIVERSITY OF DURHAM).

Professor of Chemistry.—A. Freire-Marreco, M.A.

Demonstrator.—E. Haigh.

Junior Division—General Principles of Chemistry History of the Non-Metallic Elements.

History of the Metals and their more important compounds; Principles of Qualitative Analysis, Monday, Wednesday, and Friday, at 11 a.m.

Senior Division—Elements of Organic Chemistry, Tuesdays, at 11 a.m. Applied Chemistry, Thursdays, at 11 a.m. Fee, £5 5s.

Practical Chemistry.—The Laboratory is open from 10 a.m. to 1 p.m., and from 2 to 5 p.m., except on Saturday, when it closes at 1 p.m.

Laboratory Fees.—Students working six days per week, five guineas per term. Students working alternate days. three guineas per term. Students working one day per week, one guinea per term.

Evening Classes—Prof. A. Freire-Marreco, M.A., Twenty Lectures on Inorganic Chemistry, Mondays, at 7.45, commencing October 20, 1873.

BOROUGH ANALYST'S LABORATORY,

1 and 3, SURREY STREET, SHEFFIELD.

Mr. A. H. Allen, F.C.S.. delivers a Course of Thirty Lectures on Inorganic Chemistry and Metallurgy. Day and Evening Classes for the practice of Analytical Chemistry and Assaying.

SHEFFIELD SCHOOL OF MEDICINE.

A Course of Forty-five Lectures on Inorganic and Organic Chemistry will be delivered during the Winter Session, by A. H. Allen, F.C.S.

The Summer Course of Practical Chemistry is conducted by Mr. Allen.

SCOTLAND.

UNIVERSITY OF EDINBURGH.

Professor of Chemistry.—Dr. A. Crum Brown, F.R.S.

SCHOOL OF MEDICINE, EDINBURGH.

Lecturer on Chemistry.—Dr. Stevenson Macadam, F.R.S.E.

The Courses of Instruction in Chemistry include its applications to Medicine, Agriculture, and the Industrial Arts; and they qualify for the University of Edinburgh and other Universities, the Royal Colleges of Physicians and Surgeons, the Navy, Army, and Indian Medical Service, and the other Medical and Public Boards.

The Lectures on Chemistry are delivered daily during the five months of the Winter Session, commencing in November. The Lectures form a complete Course, and special Lectures on Technological Chemistry are given. Tutorial Class Examinations are held during the Session.

The Instructions in Analytical Chemistry are conducted in the Laboratories at Surgeons' Hall, which are open daily under the personal superintendence of Dr. Macadam, for the instruction of gentlemen in Chemical Analysis, and the prosecution of researches in Manipulative Chemistry.

The Prelections in Practical Chemistry are also conducted in the Laboratories at Surgeons' Hall. The subjects selected for Examination are those with which Medical Students are specially called upon to exhibit a practical acquaintance.

Fees.—Lecture, £3 5s. (University Graduation, £4 4s.) Practical Chemistry (University, &c.), £3 3s.; Analytical Chemistry, £2 per month, £5 for three months, or £10 for six months.

UNIVERSITY OF GLASGOW.

Professor of Chemistry and Practical Chemistry.—Dr. Thomas Anderson, F.R.S.E.

ANDERSONIAN UNIVERSITY, GLASGOW.

Professor of Scientific Chemistry.—Dr. T. E. Thorpe.

GLASGOW MECHANICS' INSTITUTION.

Professor of Chemistry and Practical Chemistry.—Dr. R. Carter Moffat.

GLASGOW VETERINARY COLLEGE.

Professor of Chemistry.—Dr. R. Carter Moffat.

SCHOOL OF CHEMISTRY,
42, BATH STREET, GLASGOW.

Dr. Wallace. Mr. Tatlock, and Dr. Clark.

Scientific Course of Lectures on Inorganic and Organic Chemistry, by Dr. Clark. From 12 till 1 daily. Commencing Tuesday, November 4. Fee for the course, £2 2s.

Laboratory Instruction in Analytical and Practical Chemistry, from 10 till 4 daily, Saturdays excepted. Commencing Tuesday, November 4. Fee for six months, exclusive of apparatus, £10 10s.

Evening Course of Laboratory Instruction in Analytical and Practical Chemistry. Tuesday and Thursday, from 7 p.m. till 9.30 p.m. Commencing November 4. Fee for one night per week, £1 1s. per quarter. Two nights per week, £2 2s. per quarter.

Evening Course of Lectures on Chemistry, in connection with the Practical Class, by Mr. Tatlock. Every Friday, from 8 p.m. till 9 p.m. Commencing November 7. Fee for the six months' course, 5s.

Spring Course of Practical Medical Chemistry, by Dr. Clark. Commencing Tuesday, January 6. Fee, £2 2s.

Summer Course of Practical Medical Chemistry, by Dr. Clark. Commencing Tuesday, May 4. Fee, £2 2s.

CHEMICAL LABORATORY AND CLASS ROOMS,
107, BATH STREET, GLASGOW.

Conducted by Dr. Milne.

The Laboratory is open daily from 10 till 4 (Saturdays excepted), for Instruction in Practical and Analytical Chemistry. Fee for six months, exclusive of apparatus, £10 10s. Fee for one month, £2 2s. Private Pupils (number limited to three) per month, £4 4s. Students can join the Laboratory at any time.

The Practical Evening Classes for Instruction in Analysis and Testing will meet on Tuesdays and Thursdays, from 7 p.m. till 9 p.m. Commencing November 4. Fee for one night per week, including apparatus and material, £1 1s. per quarter. Fee for two nights per week, £2 2s.

IRELAND.

DUBLIN.—TRINITY COLLEGE.

Professor of Chemistry.—Dr. Apjohn, F.R.S.

ROYAL COLLEGE OF SURGEONS, DUBLIN.

Professor of Chemistry.—Dr. Barker.

QUEEN'S COLLEGE, BELFAST.

Professor of Chemistry.—Dr. Andrews, F.R.S., &c.

QUEEN'S COLLEGE, GALWAY.

Professor of Chemistry.—Dr. T. H. Rowney.

A Laboratory for Practical Instruction is attached to all the Queen's Colleges. The usual Practical Course for the Medical Boards is given in the summer.

ROYAL COLLEGE OF SCIENCE FOR IRELAND,
STEPHEN'S GREEN, DUBLIN.

This College supplies, as far as practicable, a complete Course of Instruction in Science, applicable to the Industrial Arts. The subjects of Instruction are;—Pure and Applied Mathematics, Descriptive Geometry and Mechanical Drawing, Mechanism, Theoretical and Applied Chemistry, Chemical Analysis, Physics, Botany, Zoology, Geology and Palæontology, Mineralogy, Mining, Machinery, Surveying, and Agriculture.

Professor of Theoretical Chemistry.—W. K. Sullivan, Ph.D., V.P.R.I.A.

Professor of Analytical and Applied Chemistry.—R. Galloway, F.C.S.

Assistant-Chemist.—W. Plunkett, F.C.S.

A Course of Lectures on Inorganic and Organic Chemistry is delivered by Dr. Sullivan three times a week during the Session. Fee for the entire course, £2.

A Course of Lectures on Technological Chemistry is delivered by Mr. Galloway twice a week during the Session. Fee for the course, £2.

The Chemical and Metallurgical Laboratories, under the direction of Mr. Galloway, are open every week day during the Session, except Saturday. Instruction is given in the different branches of Analytical Chemistry, including Assaying, and in the methods for performing Chemical research. Each Student is taught, not in class, but separately and independently; and he is supplied with a separate working table, with reagents, fuel, water, gas, and the larger and more expensive apparatus. Fee, for the Session of nine months, £12; or for three months, £5; or for one month, £2.

There are four Royal Scholarships, of the value of £50 each yearly, with free Education, including Laboratory Instruction, tenable for two years; two become vacant each year: they are given to Students who have been a year in the College. There are also nine Exhibitions attached to the College, of the yearly value of £50 each, with free Education, including Laboratory Instruction, tenable for three years; three become vacant each year. The Exhibitions are awarded at the annual May Examinations of the Science and Art Department.

A Diploma of Associate of the College is granted at the end of the three years' course.

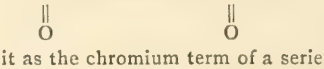
The Session commences on Monday, October 6th.

ON THE

ACTION OF CHROMYL DICHLORIDE ON IODINE.

By R. W. EMERSON McIVOR, Glasgow.

In a paper communicated to the Literary and Philosophical Society of Manchester in November, 1869 (see CHEMICAL NEWS, vol. xx., p. 245), Dr. T. E. Thorpe announced the discovery of a new chromium oxychloride, obtained by heating chromyl dichloride, $Cr^{VI}O_2Cl_2$, in sealed tubes to about 185° C., and maintaining it at that temperature for three or four hours, when it undergoes decomposition, the products being this new oxychloride and free chlorine. After having submitted this new compound to a careful study, Dr. Thorpe was induced to give it the formula $ClCr^{VI}O_2.O.{}^{IV}Cr''O.Cr^{VI}O_2Cl$, or—



and to regard it as the chromium term of a series of salts a few members of which had already been described by Peligot, viz.—

Potassium chlorochromate,		$ClCr^{VI}O_2.O.K_2.O.Cl^{VI}O_2Cl$
Sodium	,,	$ClCr\ O_2.O.Na_2.O.Cr\ O_2Cl$
Ammonium	,,	$ClCr\ O_2.O.(NH_4)_2.O.Cr\ O_2C$
Magnesium	,,	$ClCr\ O_2.O.Mg''.O.Cr\ O_2Cl$
Calcium	,,	$ClCr\ O_2.O.Ca''.O.Cr\ O_2C$

From some experiments which I recently made, I find that chromium chlorochromate, together with iodine monochloride, is formed by the action of chromyl di-

chloride, $Cr^{VI}O_2Cl_2$, prepared by heating a mixture of potassium dichromate, sodium chloride, and sulphuric acid, on dry iodine. When these two bodies are mixed in the proportions represented in the equation—

$$3Cr^{VI}O_2Cl_2 + 2I_2 = Cr_3O_6Cl_2 + 4ICl,$$

and the mixture warmed, chemical action is manifested by the production of a slight crackling noise, and the whole becoming converted into a black solid substance possessed of a very powerful chloroid smell. If the product of the action be transferred to a distillation-flask, and submitted to distillation, iodine monochloride passes over into the receiver. The then-remaining non-volatile portion is a black, brittle, amorphous, inodorous substance of a very hygroscopic nature. It is easily soluble in water, producing a dark brown-coloured solution, which smells of free chlorine. Carbon disulphide dissolves it but slightly. In strong hydrochloric acid it dissolves with a dark brown colouration, and, on boiling the solution, chlorine is evolved, the liquid becomes greenish yellow, and finally changes to the well-known green colour peculiar to an acid solution of chromic chloride. Upon boiling with dilute ammonium hydrate, chromic acid is dissolved, together with the whole of the chlorine, whilst chromate of chromium is precipitated as a greenish brown powder. When heated strongly in the air, it is resolved into chromic oxide, oxygen, and chlorine. It burns when heated in a stream of dry hydrogen gas, producing chromic oxide, water, and hydrochloric acid. Upon analysis it was found to be composed, in 100 parts, of—

Chlorine	21·58
Chromium	48·59
Oxygen (as difference) ..	29·83
	100·00

The theoretical percentage composition of Dr. Thorpe's compound being—

Chlorine	21·86
Chromium	48·54
Oxygen	29·60
	100·00

From the above considerations it is evident that the non-volatile residue consists of pure chromium chlorochromate.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 121.)

If the arms be held out horizontally, being raised direct from the sides, and not brought forward, they will be supported in that position by two muscles in each shoulder—or rather the portions of the two shoulder muscles which support them can be clearly defined and measured. The length of time for which this position can be maintained will, of course, vary considerably. The other evening I could hold mine in this position for only six minutes, that is to say, they became exhausted in this space of time. Therefore the sole power of the muscles employed was expended in maintaining the arm in that position for six minutes. Eight minutes will be found more near to the average.

Now let us consider what was happening whilst the arms were so held out. Clearly the muscles were giving off this note, that is to say, they are always giving it off when they are in action, and, therefore, the arm literally was swinging up and down, or vibrating, though to a very small and invisible extent. It would do so much more but for this peculiar arrangement; whilst the muscle contracts and produces the action that we usually call muscular action, that contraction does not take place through the entire mass of muscle at the same time. Each fibre contracts, but not in the same portion of the muscle and at the same time; there are waves succeeding waves, and the consequence is that there is, to all appearance, a steadiness in the arms through the continuity of these waves. But, as regards the action, it is the same as though that wave passed along at once. Now, if the wave passed along at once then the arm would fall, because it would oscillate or move up and down as a wave does. Knowing how often that wave passes, you would know how often the arm fell. The arm falls 32 times per second. It fails as if it were perfectly free, and if perfectly free we can easily calculate the space through which it would have fallen in the 32nd part of a second, namely, the $\frac{1}{64}$th of a foot; in other words, we have reached this stage, that the action of a muscle is such that it allows the arm to fall through the 64th part of a foot in the 32nd part of a second. Now let us get to another stage. The cause of its falling is the action of gravity upon the whole mass of the arm. You may remember that last Monday, in dealing with the pendulum, it was explained that in a compound pendulum different portions fell through different spaces, but that there is one point which we called O, termed the centre of oscillation, which may be regarded as representing the whole mass. Now, assuming a shoulder to be the point of suspension of the pendulum, it is the point O in the arm which would fall through the 64th part of a foot in the 32nd part of a second, and that point O, by a mathematical calculation, can always be found. Regarding the arm as a perfect cylinder, this point is at two-thirds of the length of the arm from the shoulder.

Again, the work done depends on the mass moved, or supported, and the mass moved is that which is calculated as at the centre of gravity, which for this purpose is about the elbow—about eleven inches from the shoulder. Therefore, assuming the arm to be 24 inches, then the point O at 16 inches from the shoulder, falls through the 64th part of a foot, in the 32nd part of a second, and it is very easy from that to ascertain how far the point at 11 inches from the shoulder, representing the whole weight of the arm, would fall in the same interval of time. We have, therefore, got the centre of gravity, the weight of the arm, and the distance it falls.* We consequently have all the elements wanted. We have the mass, the weight of the arm, the space (the $\frac{1}{64}$th of the foot), and the time ($\frac{1}{32}$nd of a second), Without going into the question of mathematics, the work done under these circumstances, as regards my own arm, was this, that I was able to do with both arms 1980 lbs. in the six minutes that elapsed before fatigue came on; in other words, the work done was the same as though I had lifted 1980 lbs. 1 foot high—1980 lbs. is very nearly 18 cwts. That is to say, the work that these two arms did in falling through that space, and being lifted back again, was very little short of a ton. If any one wants to know how much work the human arm is capable of doing when working on its own account, he may raise weights amounting to 9 cwts. on to a stool 1 foot high, and he would then ascertain the exact work that each arm did when left to support itself. Such is an outline of the mode in which the calculation is made. If there are any persons interested in it, as a question of actual calculation, a table on the wall may be of interest.†

* The Cantor Lectures, delivered before the Society of Arts.

* Dr. H. calls his and many other similar experiments "Statical," although [illegible] motion, because the muscles are kept in continued contraction until tired out, and undergo no translation in [illegible] within the muscles to which the work done is altogether due.

† To find the work done in holding arms horizontal, time before exhaustion [illegible] minutes:—

From measurement, length of each arm is 24 inches.

From weighing, weight of each arm is 8 lbs.

From muscular note, vibration of each arm is 32 times per second.

From tables, centre of oscillation of each arm is 2·8ths of 24 inches, or 16 inches from shoulder.

From inspection, centre of gravity of each arm is 11 inches from shoulder.

The arm in this case was held steady, and doing what may be called static work, as distinguished from that which is dynamical or kinetic. Dr. Haughton took very great pains to ascertain the exact weight of these muscles in the shoulder. This was done thus:—There is a large muscle called the "deltoid" muscle; a portion only of this muscle is engaged in the work. After careful examination in various ways Dr. Haughton concluded that $\frac{1}{8}^{0}$ths of this muscle is employed in the experiment. It would be out of place to enter into these details here; it may, however, be of general interest to place this investigation before you in a tabular form.

	Ozs. avoir.
Average weight of superspinatus muscle ..	1671
Average of portion of deltoid	2830
	4501

Therefore 4·5 ozs. perform, on an average, 1206·5 ft.-lbs.
" 1 oz. performs 268 ft.-lbs. before being exhausted.

As this exhaustion is complete in 8·29 minutes, the average duration of endurance, 1 oz. in 1 minute does $\frac{268}{8{\cdot}29}$ = 32·3 ft.-lbs.

On one occasion these muscles were weighed and measured within 40 minutes after the execution of a criminal, so as to ascertain the exact size of them under circumstances where there had been no wasting from exhaustion. With the shoulder unloaded, the muscle was tired out in 8·29 minutes on an average of experiments. The weight of the muscles employed was 4¼ ozs., and the work they did on an average was equivalent to the lifting of 1206 lbs. through a foot. The weight lifted through one foot for 1 ounce of muscle would be 32 lbs. He then put a weight of 2 lbs. in each hand, and held them out as before until fatigued, and he found the muscles were exhausted in 4 minutes, but the amount of work which each ounce of muscle did was 46 lbs., so that it did more work than it did before. Now, the power of the heart to send blood into the muscles, to keep up the action there, is not, in this case, equal to the action or work required from them; hence they began to fail in 4 minutes, whereas, in the other case, they kept at work for 8 minutes. In fact, the power exactly balanced the work in the 8 minutes; but it fell rather short in 4 minutes. An experiment was tried in another form, namely, hanging a weight on the wrist and keeping the elbow close to the side, a different muscle (biceps) came into play. This muscle weighs about 8 ozs.; the power lasted 9¼ minutes, and the weight, per ounce of muscle, lifted was 41.

Now, coming to dynamical work, when the muscles are engaged in producing motion, the muscles of the trunk of the body are employed simply in supplying the other muscles with that upon which they live during the time they are at work; they do no external work themselves. This was alluded to in an early part of the lecture, when told that there are certain muscles which act involuntarily; for example, if the heart cannot propel blood as fast as the muscle needs it, and if the will insists upon that muscle doing further work, then the heart is called upon to do what it cannot do, and death ensues. The two must be harmonised; and where this harmony is broken, as sometimes happens, in a boat-race, and other cases of violent exertion, accident or death results.

Statical Work Done by Muscles.

Muscles used.	Work in foot-pounds.	Duration of labour, in minutes.	Weight of muscles in ounces avoir.	Rate of work in foot-lbs. per oz. per min
Unloaded muscles of shoulder ..	1206	8·29	4·50	32·3
Loaded muscles of shoulder	842	4·05	4·50	46·2
Loaded muscles of forearm	3170	9·29	8·21	41·5

Dynamical Work Done by Muscles of the Whole Body.

Kind of Work.	Quantity of work in foot-pounds.	Duration of labour in minutes.	Weight of muscles in oz. avoir. dupois.	Rate of work in ft.-lbs. per oz. per minute.
Boat race	61,040	7	575	15·17
Barrow lift	2,038,400	480	575	7·39
Running with load	10,091	0·55	575	35·11
Day labour	792,400	600	575	2·30

This table shows the results of experiments on different kinds of work. First, there is the case of a boat race which was rowed in seven minutes. The whole weight of the muscles employed in actually doing the work, viz., those in the arms and legs, was 575 ozs.; the work done, making all allowances for the weight of the boat and the people in it, &c., was equivalent to 60,040 lbs. raised through a foot, giving an average of only 15 lbs. per ounce per minute, so that the contrast is very great between static work and dynamical work, the former being three times as great. Next comes an instance bringing into play all the active muscles of the body. It was a plan adopted in some railway works, raising rubble from a great depth. There was a pulley at the top of a shaft, over which passed a rope, and a stage at each side large enough to carry a barrow. One barrow was filled at the bottom, then a man stepped into the empty barrow at the top, and his weight in falling to the bottom of the shaft lifted the barrow full of earth. He then ran up a ladder to the top, and was ready to descend again. By that means his own weight lifted up the full barrow of earth. With work like that a man worked for 480 minutes, and he did two millions of units of work. Compared with the boat race he was only half as industrious, and the length of time was very much greater, but he only did 7·39 foot-lbs. per oz. per minute. In the next case a man ran with a load upon his shoulders, and his muscular power was knocked up in half a minute, but the work he did was 35 foot-lbs. per minute, approaching very nearly the static work. Last comes a day labourer, who generally takes it very easy, and it appears he only does 2 foot-lbs. per oz. per minute, so that if he complains of getting small pay he does little work for it; it must be remembered, however, that he works for 10 hours a day at it.

Time warns me to close. It may, however, be of interest to state that, calculated as machinery would be calculated, the heart receives and propels the whole amount of blood in the human body in 42 seconds.

To those who care for the subject of this evening's lecture, and have not altogether laid aside their mathematical knowledge, the information in Dr. Haughton's book will prove both instructive and interesting. To follow up the investigation, they may study the action of a horse in walking and drawing a load, also the construction of carriages, so that the animal may most easily raise a

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Now from the usual expression—

$$S = \tfrac{1}{2} G T^2$$

$$\text{In this case } S = \tfrac{1}{2} 32 \left(\tfrac{1}{32}\right)^2$$

$$= \frac{1}{64} \text{ foot.}$$

Therefore centre of oscillation falls through $\frac{1}{64}$ ft. in $\frac{1}{32}$ of a second,

or " " " $\frac{60{\cdot}32}{64}$ *i.e.*, 30 feet in one minute.

If at 16 inches from the shoulder there is a fall of 30 feet per minute, then at 11 inches from the shoulder there is a fall of $\frac{11{\cdot}30}{16}$ feet per minute.

Therefore the work done by one arm is $\frac{8{\cdot}11{\cdot}30}{16}$ ft.-lbs. per minute.

" " " 165 ft.-lbs. " "

Therefore total work by both arms before exhaustion is 165·6·2 ft.-lbs., or 1980 ft.-lbs., that is nearly 18 cwt, lifted through one foot in six minutes.

loaded cart over an obstacle on the road, and, further, decide upon the inclination of the traces to the roadway. These being done, the investigator will find much scope for original work in examining the various ways in which horses are harnessed so as to utilise their vital energies. This done, boats and bicyles, as means of utilising muscular energy, are worthy of thought. Perplexity and confusion seem to be stamped upon modern usages in these matters, and the conclusion is forced upon us that the utilisation of the vital energies has not yet been reduced to a system.

(To be continued).

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, August 18, 1873.

Fourth Notice on Guano.—M. Chevreul.—The author gives a description of a crystalline matter extracted by cold water from the guano, and of another complex substance insoluble in cold water. It contains a considerable amount of avic acid, but does not give off the odour of this body until treated with alcohol. "Lastly, in the residue of the guano, after exhaustion with cold water, boiling alcohol, and boiling water, there remains phosphate of lime in a particular state, to which I shall return in a final notice, where I shall show how my experiments throw a new light upon the part played by guano in agriculture, and how it realises in practice all the theoretical views which I have made known thirty years ago on the conception of a typical manure."

Ammoni-Nitrometry; a new System for Determining Ammonia and Nitrogen in Organic Compounds, and Nitric Acid in Natural Waters, Soils, and Manures.—M. Piuggari.—The most important data to be determined in all these cases are ammonia, free and combined, nitrogen existing in organic matters, and nitric acid or nitre derived from the oxidation of such matters. The general means to be employed are oxidation and reduction; but as all the agents employed hitherto are neither energetic nor pure enough to give results sufficiently exact, the author adopts, at once as oxidising and as reducing agent for organic matters, a mixture of chloride of silver, moist and recently precipitated, and of very pure hydrate of potassa. These substances, which are very energetic, and which may be obtained quite free from ammonia, are allowed to act for two or three hours at a temperature of 55° to 60°. By this action all the nitrogen of the organic matters is transformed into ammonia, nitrous, and nitric acid; the two latter of which are then transformed into ammonia by reducing agents. The reducing agent which the author employs in this case—as in all those where it is required to reduce and determine nitrous compounds—is nascent hydrogen produced by aluminium filings, and a pure alkaline hydrate at a temperature which ought not to exceed that of boiling water. The process is continued for half-an-hour to an hour according to the amount of the matter to be reduced, and the ammonia is then distilled off. The author has convinced himself of the complete reduction by this process of organic matters and nitrous compounds by experimenting with types of known composition, such as morphia, codeia, strychnia, albumen gelatin, and uric acid. The amount of albumen obtained has been in accordance with theory, with a difference of at most 1 to 3 per cent, due doubtless to the very small quantities operated upon—0·0005 grm. to 0·0002 grm. per half litre of water. The ammonia distilled over is determined by Nessler's test if the quantities are very small. If they exceed $\frac{1}{100}$th of a milligrm. of ammonia per cubic centimetre, the determination is effected by means of a special reagent, founded on the reaction of 1 or 2 drops of phenol, and 5 to 6 c.c. of hypochlorite of soda added to the liquid to be tested. This reagent gives with the distilled ammoniacal liquid a fine blue violet colouration, soluble and very stable; the intensity of which may be compared with a normal liquor by means of Collardeau's colorimeter.

Hydrochlorate of Tereben, and the Isomerism of the Compounds of the Formula $C_{10}H_{16}HCl$.—M. J. Ribau.—The hydrochlorate of tereben is completely without action upon polarised light; it forms crystals of a camphor-like odour, and recalls in certain respects the hydrochlorates of terebenthen and camphen. Its composition is:—

Carbon	69·58
Hydrogen	9·85
Chlorine	20·57
	100·00

It melts at 125°, and is quickly decomposed by water, which removes the bulk of the hydrochloric acid, converting the substance into a mixture of a crystalline carbide, $C_{10}H_{16}$, which the author calls β-camphen, and of undecomposed hydrochlorate. The hydrochlorate dissolves in hot absolute alcohol; and if the temperature of 55° to 60° is not exceeded the bulk of the product is deposited in fine transparent laminæ, not containing more than 17 to 18 per cent of chlorine. The author concludes that the hydrochlorate of terebenthen is undecomposable by cold water, and yields only traces of hydrochloric acid at 100°. The hydrochlorates of camphen are slowly decomposed by cold water, and by the same liquid at the boiling-point; the primitive crystalline camphen being regenerated. The hydrochloric ethers of the two borneols experience an analogous decomposition under the same circumstances, but with less intensity. The hydrochlorate of tereben is dissociated at ordinary temperatures; it is decomposed most rapidly by the action of cold water, and under the same influence at 100° furnishes only liquid compounds, contrary to what has been observed with the liquid combinations of the camphens and the borneols.

Direct Demonstration of the Fundamental Principles of Thermo-Dynamics.—(Continued.)—M. Ledieu.—This treats of the fundamental relation between the quantity of heat applied to a body, the change of temperature, and the variation and duration of the vibrations.

Letter from M. Nordenskjöld on Carbonaceous Dust, with Metallic Iron, observed in Snow (Dated from Mossel Bay, lat. 79° 53′ N.; Received at Tromsöe, July 24).—The writer remarks that in December, 1871, he found in some snow collected towards the end of a five or six days continuous fall in Stockholm a large quantity of dark powder like soot, and consisting of an organic substance rich in carbon. It was like the meteoric dust which fell with meteorites at Hessle near Upsal in Jan., 1869. It contained also small particles of metallic iron. Suspecting the railways and houses of Stockholm might have furnished these matters, he got his brother, who lived in a desert district in Finland, to make similar experiments; which he did, and obtained a similar powder. In his Arctic voyage the writer has met with like phenomena. The snow from floating ice has furnished on fusion a greyish residue consisting mostly of diatoms (whole or injured); but the black specks, a quarter of a millimetre in size, contained metallic iron covered with oxide of iron, and probably also carbon.

He thinks, therefore, that snow and rain convey cosmic dust to the earth, and invites further observation on the subject. M. Daubree, in presenting the letter, recalled a case of meteoric dust having fallen at Orgueil in 1864. He expressed the hope that M. Nordenskjöld has obtained sufficient quantities of pulverulent matter to be able to determine a characteristic fact—the presence or absence of nickel.

The Cryptograph of M. Pelegrin.—M. Dupuy de Lôme.—The cryptograph is described as an instrument designed to be raised on the ground, and to convert into expressions capable of being transmitted directly and secretly by telegraph, the polar co-ordinates of points which determine a given figure; whence the possibility with this instrument of following and interpreting, that is, of drawing, in Paris, *e.g.*, what correspondents in different parts of the country in telegraphic communication with Paris may see and telegraph but do not interpret.

Experimental Researches on Explosive Matters.—MM. Roux and Larran.—The authors formerly determined the heat of combustion of five kinds of powder made in France. They here determine for these powders the volume of the gaseous products of combustion reduced to zero and 0·76 m. Their tables also give the numbers expressing heat of combustion; the pressure of the permanent gases of 1 kilo. of powder, having at the temperature T of the flame a volume equal 1 litre; and the maximum work produced by indefinite expansion of the gases of 1 kilo. Some other substances, as gun-cotton, dynamite, were also experimented with.

Variations of Hæmoglobin in the Zoological Series.—M. Quinquaud,—The progressive diminution of quantity of hæmoglobin in the same volume of blood generally follows the animal scale; but primates have not most hæmoglobin. Young animals have less than adults. From about 25 to 50 years in man the proportion is pretty constant; thereafter it diminishes. Birds have much less hæmoglobin than mammals. Females have less than males. The lymph of crustacea has 4 to 5 c.c. of oxygen per cent, while ordinary water, at its maximum of saturation in winter, contains only 1 c.c. per cent; and in summer, $\frac{1}{10}$ c.c. M. Quinquaud gives a list of animals, with the proportion of hæmoglobin in each.

Former Existence during the Quaternary Period of a Large Glacier in the Mountains of Aubrac (Lozére).—M. G. Faber.

Three Short Notes on Falling Stars.—MM. Dufour, Tisserand, and Chapeler respectively.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxi., No. 18, August 28, 1873.

Relation between the Atomic Weight, the Specific Gravity, and the Hardness of the Metallic Elements.—S. Bottone.—The author holds that the hardness of any metallic element has for its natural measure the quotient or ratio of the specific gravity divided by the atomic weight. The theoretical results thus obtained agree closely with the hardness determined experimentally by causing a cylinder of steel to penetrate to a constant depth into the metal in question by means of a determinate rotatory movement.

MISCELLANEOUS.

The Adulteration Act.—Mr. Alfred G. Anderson has been elected Analyst to the Vestry of St. Martin-in-the-Fields, London.

Birkbeck Literary and Scientific Institution.—This Institution has just issued its prospectus for the winter session. Evening classes for ladies and gentlemen have been arranged in all branches of education, and a class is announced for the preparation of candidates for the Civil Service Open Competitions. Professor Fawcett, M.P., has kindly consented to deliver an address in commemoration of the opening of the fiftieth session. During the vacation the interior of the lecture theatre has been entirely reconstructed. The list of lectures contains the names of several of the most popular occupants of the platform. Important additions have been made to the library, and the reading room is well supplied with current literature.

British Association for the Advancement of SCIENCE,

The Forty-third ANNUAL MEETING of this Association will be held in BRADFORD, commencing on WEDNESDAY, September 17, 1873.

President Designate:
Professor A. W. WILLIAMSON, Ph.D., F.R.S., F.C.S.

Election of Members and Associates.

The Executive Committee at Bradford will elect New Members and Associates, on the following conditions:—

I. New Life Members for a composition of £10, which entitles them to receive gratuitously the Reports of the Association which may be published after the date of payment.

II. New Annual Subscribers for a payment of £2 for the first year. They receive gratuitously the Reports for the year of their admission and for every following year in which they continue to pay a Subscription of £1 *without intermission.*

III. Associates for this Meeting only for a payment of £1. They are entitled to receive the Report of the Meeting at two-thirds of the publication price. Associates are not eligible to serve on Committees or to hold any office.

Ladies may become Members or Associates on the same terms as Gentlemen. Ladies' Tickets (*transferable to Ladies only*) may be obtained on payment of £1. Cheques and Post-Office Orders to be made payable to Alfred Harris, Jun., Esq., Bradford.

After September 13, personal application for Tickets must be made at the Reception Room, Bradford, which will be opened on Monday, September 15, at 1 p.m.

General and Evening Meetings in St. George's Hall.

The First General Meeting will be held on Wednesday, September 17, at 8 p.m. precisely, when Dr. CARPENTER, LL.D., F.R.S., &c., will resign the Chair, and the President Elect will assume the Presidency, and deliver an Address. On Thursday, Evening, September 18, at 8 p.m., a Soirée; on Friday Evening, September 19, at 8.30 p.m., a Discourse by Professor W. C. Williamson, F.R.S., of Manchester, on Coal and Coal Plants; on Saturday Evening, September 20, a Lecture on Fuel, to Working Men only, by Mr. Siemens, F.R.S.; on Monday Evening, September 22, at 8.30 p.m., a Discourse on Molecules, by Professor Clerk Maxwell, F.R.S.; on Tuesday Evening, September 23, at 8 p.m., a Soirée; on Wednesday, September 24, the concluding General Meeting will be held at 2.30 p.m., and in the Evening a Grand Concert will be given in St. George's Hall, at 8 p.m.

EXCURSIONS on Thursday, the 25th September, to the following places of interest have been arranged:—Harrogate, Ripon, Studley, Bolton Abbey, Gordale Scarr, Malham, Clapham Caves, Settle Caves, and Ingleboro'.

Lists and Prices of Lodgings, and other general information will be given, on application at the Local Secretaries' Office, Bradford.

The names of New LIFE MEMBERS, ANNUAL SUBSCRIBERS, and ASSOCIATES for this Meeting only, are now being received and Tickets issued at the Offices of the Association, Market Street; also Tickets for Ladies who do not desire to become Members or Associates: these are *transferable to Ladies only.*

JAMES R. CAMPBELL, D.D.,
RICHARD GODDARD,
PEILE THOMPSON,
} Hon. Local Secretaries.

North London School of Chemistry, Pharmacy, &c. Established 12 years.—Conducted by Mr. J. C. BRAITHWAITE, *for thirteen years Principal Instructor* in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c.

The Session 1873-1874 commences on the 1st of October, when—

The LABORATORY will be open for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Terms moderate.

The CLASSES for CHEMISTRY, MATERIA MEDICA, BOTANY, and LATIN, meet as usual at 8 p.m.

Fee to either Class Half-a-Guinea per Month. Pupils desirous of doing so can attend until qualified for one inclusive Fee.

The BOTANICAL GARDEN affords every facility to Students desirous of acquiring a *Practical Knowledge of Botany.* During the Season BOTANICAL EXCURSIONS are made every Saturday at 10 a.m.

As each Pupil works independently, he can enter at any period to either Classes or Laboratory.

All Fees must be paid in advance.

PRIVATE TUITION for the Preliminary Modified Minor and Major Examinations, &c.

A few Pupils received to Board in the house.

Applications, accompanied with a stamped envelope, addressed to—

54, KENTISH TOWN ROAD, N.W.

THE CHEMICAL NEWS.

Vol. XXVIII. No. 721.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Bradford Meeting, September 17, 1873.

INAUGURAL ADDRESS OF THE PRESIDENT,

Alexander W. Williamson, Ph.D., F.R.S., F.C.S.

Ladies and Gentlemen,—

Instead of rising to address you on this occasion, I had hoped to sit quietly amongst you, and to enjoy the intellectual treat of listening to the words of a man of whom England may well be proud—a man whose life has been spent in reading the great book of nature, for the purpose of enriching his fellow men with a knowledge of its truths—a man whose name is known and honoured in every corner of this planet to which a knowledge of science has penetrated—and, let me add, a man whose name will live in the grateful memory of mankind as long as the records of such noble work are preserved.

At the last Meeting of the British Association I had the pleasure of proposing that Dr. Joule be elected President for the Bradford Meeting, and our Council succeeded in overcoming his reluctance and in persuading him to accept that office.

Nobly would Joule have discharged the duties of President had his bodily health been equal to the task; but it became apparent after a while that he could not rely upon sufficient strength to justify him in performing the duties of the chair, and, in obedience to the orders of his physician, he placed his resignation in the hands of the Council about two months ago. When, under these circumstances, the Council did me the great honour of asking me to accept their nomination to the Presidentship, I felt that their request ought to have with me the weight of a command.

For a good many years past Chemistry has been growing at a more and more rapid rate, growing in the number and variety of facts which are added to its domain, and not less remarkably in the clearness and consistency of the ideas by which these facts are explained and systematised. The current literature of chemical research extends each year to the dimensions of a small library; and mere brief abstracts of the original papers published annually by the Chemical Society, partly aided by a grant from this Association, take up the chief part of a very stout volume. I could not, if I would, give you to-night even an outline of the chief newly discovered compounds and of the various changes which they undergo, describing each of them by its own name (often a very long one) and recording the specific properties which give to each substance its highest scientific interest. But I am sure that you would not wish me to do so if I could; for we do not meet here to study chemistry; I conceive that we meet here for the purpose of considering what this wondrous activity in our science means, what is the use of it, and, true to our object as embodied in the name of this Association, to consider what we can do to promote the Advancement of Science. I propose to lay before you some facts bearing on each of these questions, and to submit to you some considerations respecting them.

In order to ascertain the meaning of the work which has been going on in chemistry, it will, I think, be desirable for us to consider the leading ideas which have been in the minds of chemists, and which guided their operations.

Now, since the father of modern chemistry, the great Dalton, gave to chemists a firm hold of the idea of Atoms, their labours have been continually guided by that fundamental idea, and have confirmed it by a knowledge of more and more facts, while at the same time steadily adding to our knowledge of the properties of atoms. Every chemist who is investigating a new compound takes for granted that it must consist of a great number of atom-clusters (called by him molecules), all of them alike, and each molecule consisting of a certain number of atoms of at least two kinds. One of his first endeavours is to ascertain how many atoms of each kind there are in each molecule of the compound. I must not attempt to describe to you the various kinds of experiment which he performs for the purpose of getting this information, how each experiment is carried out with the aid of delicate instruments and ingenious contrivances found by long experience to enable him to obtain the most trustworthy and accurate results; but I want to draw your attention to the reasoning by which he judges of the value of such experiments when they agree among themselves, and to the meaning which he attaches to their result.

If the result of his experiments does not nearly agree with any atomic formula (that is, if no conceivable cluster of atoms of the kinds known to be in the compound would on analysis give such results as those obtained), the chemist feels sure that his experiments must have been faulty: either the sample of substance which he worked upon contained foreign matter, or his analyses were not made with due care. He sets to work again, and goes on till he arrives at a result which is consistent with his knowledge of the combining properties of atoms. It is hardly necessary to say that even the best experiment is liable to error, and that even a result obtained with the utmost care cannot be expected to afford more than an approximation to the truth. Every good analysis of a pure compound leads to results which approximate to those required by the Atomic Theory; and chemists trust so thoroughly to the truth of that guide, that they correct the results of such analysis by the aid of it.

The chemical idea of atoms serves for two purposes:—

(1). It gives a clear and consistent explanation of an immense number of facts discovered by experiment, and enables us to compare them with one another and to classify them.

(2). It leads to the anticipation of new facts, by suggesting new compounds which may be made; at the same time it teaches us that no compounds can exist with their constituents in any other than atomic proportions, and that experiments which imply the existence of any such compound are faulty.

We have the testimony of the great Berzelius to the flood of light which the idea of atoms at once threw on the facts respecting combining proportions which had been accumulated before it was made known; and from that time forward its value has rapidly increased as each succeeding year augmented the number of facts which it explained.

Allow me at this point of my narrative to pause for a moment in order to pay a tribute of respect and gratitude to the memory of one who has recently passed from among us, and who in the time of his full activity was a leader of the discoveries of new facts in the most difficult part of our science. Liebig has been generally known in this country through his writings on agricultural chemistry, through his justly popular letters on chemistry, and other writings, by means of which his brilliant intellect and ardent imagination stimulated men to think and to work. Among chemists he was famed for his numerous discoveries of new organic compounds, and their investigation by the aid of improved methods; but I believe that the greatest service which his genius rendered to science was the establishment of the chemical school of Giessen, the prototype of the numerous chemical schools for which

Germany is now so justly celebrated. I think it is not too much to say that the Giessen laboratory, as it existed some thirty years ago, was the most efficient organisation for the promotion of chemistry which had ever existed.

Picture to yourselves a little community of which each member was fired with enthusiasm for learning by the genius of the great master, and of which the best energies were concentrated on the one object of experimental investigation.

The students were for the most part men who had gone through a full curriculum of ordinary studies at some other university, and who were attracted from various parts of the world by the fame of this school of research.

Most of the leading workers of the next generation were pupils of Liebig; and many of them have established similar schools of research.

We must not, however, overlook the fact that Liebig's genius and enthusiasm would have been powerless in doing this admirable work, had not the rulers of his Grand Duchy been enlightened enough to know that it was their duty to supply him with the material aids requisite for its successful accomplishment.

Numberless new compounds have been discovered under the guidance of the idea of atoms; and in proportion as our knowledge of substances and of their properties became more extensive, and our view of their characteristics more accurate and general, were we able to perceive the outlines of their natural arrangement, and to recognise the distinctive characteristics of various classes of substances. I wish I could have the pleasure of describing to you the origin and nature of some of these admirable discoveries, such as homologous series, types, radicals, &c.; but it is more to our purpose to consider the effect which they have had upon the idea of atoms, an idea which, still in its infancy, was plunged into the intellectual turmoil arising from a variety of novel and original theories suggested respectively by independent workers as best suited for the explanation of the particular phenomena to which their attention was mainly directed.

Each of these workers was inclined to attach quite sufficient importance to his own new idea, and to sacrifice for its sake any other one capable of interfering with its due development.

The father of the atomic theory was no more; and the little infant had no chance of life, unless from its own sterling merits it were found useful in the work still going on.

What then was the result? Did it perish like an ephemeral creation of human fancy? or did it survive and gain strength by the inquiries of those who questioned Nature and knew how to read her answers?

Although anticipating my answer to these questions, you will probably be surprised to hear the actual result which I have to record, a result so wonderful that the more I think of it the more I marvel at it. Not only did these various theories contain nothing at variance with the atomic theory; they were found to be natural and necessary developments of it, and to serve for its application to a variety of phenomena which were unknown to its founder.

Among the improvements of our knowledge of atoms which have taken place, I ought to mention the better evaluations of the relative weight of atoms of different kinds, which have been made since Dalton's time. More accurate experiments than those which were then on record have shown us that certain atoms are a little heavier or lighter than was then believed, and the work of perfecting our observations is constantly going on with the aid of better instruments and methods of operation. But, apart from these special corrections, a more sweeping change has taken place, not in consequence of more accurate experiments interpreted in the usual way, but in consequence of a more comprehensive view of the best experimental results which had been obtained, and a more consistent interpretation of them. Thus the atomic weight of carbon had been fixed at 6 by Dumas's admirable experiments; and it was quite conceivable that a still more perfect determination might slightly increase or diminish this number. But those who introduced the more sweeping change asserted in substance that two of these supposed atoms, whatever may be the precise weight of each, always are together and never separate from one another; and they accordingly applied the term atom to that indivisible mass of carbon weighing twice as much as a carbon atom had been supposed to weigh. So also with regard to other elements, it has been shown that many atoms are really twice as heavy as had been supposed, according to the original interpretation of the best experiments. This change was brought about by what I may be permitted to call the operation of stock-taking. Dalton first took stock of our quantitative facts in a business-like manner; but the amount and variety of our chemical stock increased so enormously after his time, that the second stock-taking absorbed the labours of several men for a good many years. They were men of different countries and very various turns of mind; but, as I mentioned just now, they found no other fundamental idea to work with than Dalton's; and the result of their labours has been to confirm the truth of that idea and to extend greatly its application.

One of the results of our endeavours to classify substances according to their natural resemblances has been the discovery of distinct family relationships among atoms, each family being distinguished by definite characteristics. Now, among the properties which thus characterise particular families of atoms, there is one of which the knowledge gradually worked out by the labours of an immense number of investigators must be admitted to constitute one of the most important additions ever made to our knowledge of these little masses.

I will endeavour to explain it to you by a simple example. An atom of chlorine is able to combine with 1 atom of hydrogen or 1 atom of potassium; but it cannot combine with 2 atoms. An atom of oxygen, on the other hand, can combine with 2 atoms of hydrogen or with 2 atoms of potassium, or with 1 atom of hydrogen and 1 of potassium; but we cannot get it in combination with 1 atom of hydrogen or of potassium solely.

Again, an atom of nitrogen is known in combination with 3 atoms of hydrogen; while an atom of carbon combines with 4 of hydrogen. Other atoms are classified, from their resemblance to these respectively, as Monads, Dyads, Triads, Tetrads, &c.

The combining value which we thus recognise in the atoms of these several classes has led us naturally to a consideration of the order in which atoms are arranged in a molecule. Thus, in the compound of oxygen with hydrogen and potassium, each of these latter atoms is directly combined with the oxygen, and the atom of oxygen serves as a connecting link between them. Hydrogen and potassium have never been found capable of uniting directly with one another; but when both combined with 1 atom of oxygen they are in what may be called indirect combination with one another through the medium of that oxygen.

One of the great difficulties of chemistry some few years ago was to explain the constitution of isomeric compounds, those compounds whose molecules contain atoms of like kinds and in equal numbers, but which differ from one another in their properties. Thus a molecule of common ether contains 4 atoms of carbon, 10 atoms of hydrogen, and 1 of oxygen. Butylic alcohol, a very different substance, has precisely the same composition. We now know that in the former the atom of oxygen is in the middle of a chain of carbon atoms, whereas in the latter it is at one end of that chain. You might fancy it impossible to decide upon anything like consistent evidence such questions as this; but I can assure you that the atomic theory, as now used by chemists, leads frequently to conclusions of this kind, which are confirmed by independent observers, and command general assent.

That these conclusions are, as far as they go, true descriptions of natural phenomena is shown by the fact that each of them serves in its turn as a stepping-stone to further discoveries.

One other extension of our knowledge of atoms I must briefly mention, one which has as yet received but little attention, yet which will, I venture to think, be found serviceable in the study of the forces which bring about chemical change.

The original view of the constitution of molecules was statical; and chemists only took cognizance of those changes of place among their atoms which result in the disappearance of the molecules employed, and the appearance of new molecules formed by their reaction on one another. Thus, when a solution of common salt (sodic chloride) is mixed with a solution of silver nitrate, it is well known that the metallic atoms in these respective compounds change places with one another, forming silver chloride and sodic nitrate; for the silver chloride soon settles to the bottom of the solution in the form of an insoluble powder, while the other product remains dissolved in the liquid. But as long as the solution of salt remained undecomposed, each little molecule in it was supposed to be chemically at rest. A particular atom of sodium which was combined with an atom of chlorine was supposed to remain steadily fixed to it. When this inactive solution was mixed with the similarly inactive solution of silver nitrate, the interchange of atoms known to take place between their respective molecules was nominally explained by the force of predisposing affinity. It was, in fact, supposed that the properties of the new compounds existed and produced effects before the compounds themselves had been formed.

I had occasion to point out a good many years ago that molecules which appear to be chemically at rest are reacting on one another when in suitable conditions, in the same kind of way as those which are manifestly in a state of chemical change—that, for instance, the molecules of liquid sodic chloride exchange sodium atoms with one another, forming new molecules of the same compound undistinguishable from the first, so that, in an aggregate of like molecules, the apparent atomic rest is the result of the interchange of like atoms between contiguous molecules.

Such exchanges of atoms take place not only between molecules of identical composition, but also between contiguous molecules containing different elements. For instance, in a mixture of sodic chloride and potassic iodide an interchange of metallic atoms takes place, forming potassic chloride and sodic iodide. The result of the exchange in such a case is to form a couple of new molecules different from the original couple. But these products are subject to the samegeneral law of atomic exchanges, and their action on one another reproduces a couple of molecules of the materials.

Thus a liquid mixture formed from two compounds, contains molecules of four kinds, which we may describe as the two materials and the two products. The materials are reacting on one another, forming the products; and these products are, in their turn, reacting on one another, reproducing the materials.

If one of the products of atomic exchange between two molecules is a solid while the other remains liquid (as when sodic chloride is mixed with silver nitrate), or if one is gaseous while the other remains liquid, so that the molecules of the one kind cannot react on those of the other kind and reproduce the materials, then the continued reaction of the materials on one another leads to their complete mutual decomposition. Such complete mutual decomposition of two salts take place whenever they react on one another under such conditions that the products cannot react on one another and reproduce the materials; whereas partial decomposition takes place whenever the materials form a homogeneous mixture with the products.

Now, if in any such homogeneous mixture more exchanges of atoms take place between the materials than between the products, the number of molecules of the products is increased, because more of them are being made than unmade; and reciprocally, if more exchanges of atoms take place between the products than between the materials, the number of molecules of the materials is increased. The mixture remains of constant composition when there are in the unit of time as many decomposing changes as reproducing changes.

Suppose that we were to determine by experiment the proportion between the number of molecules of the materials, and the number of molecules of the products, in a mixture the composition of which remains constant, and that we found, for instance, twice as many of materials as of products; what would this mean? Why, if every two couples of materials only effect in the unit of time as many exchanges as every one couple of products, every couple of materials is only exchanging half as fast as every couple of products.

In fact you perceive that a determination of the proportion in which the substances are present in such a mixture will give us a measure of the relative velocities of those particular atomic motions; and we may thus express our result:—The force of chemical combination is inversely proportional to the number of atomic interchanges.

I cannot quit this part of our subject without alluding to the fact that some few chemists of such eminence as to be entitled to the most respectful attention, have of late years expressed an opinion that the idea of atoms is not necessary for the explanation of the changes in the chemical constitution of matter, and have sought as far as possible to exclude from their language any allusion to atoms.

It would be out of place on this occasion to enter into any discussion of the questions thus raised; but I think it right to point out:—

I. That these objectors have not shown us any inconsistency in the atomic theory, nor in the conclusions to which it leads.

II. That neither these nor any other philosophers have been able to explain the facts of chemistry on the assumption that there are no atoms, but that matter is infinitely divisible.

III. That when they interpret their analyses, these chemists allow themselves neither more nor less latitude than the Atomic Theory allows; in fact they are unconsciously guided by it.

These facts need no comment from me.

Our science grows by the acquisition of new facts which have an intelligible place among our ideas of the order of nature; but in proportion as more and more facts are arranged before us in their natural order, in proportion as our view of the order of nature becomes clearer and broader, we are able to observe and describe that order more fully and more accurately—in fact, to improve our ideas of the order of nature. These more extensive and more accurate ideas suggest new observations, and lead to the discovery of truths which would have found no place in the narrower and less accurate system. Take away from Chemistry the ideas which connect and explain the multifarious facts observed, and it is no longer a science; it is nothing more than a confused and useless heap of materials.

The answer to our question respecting the meaning of the earnest work which is going on in our science must, I think, now be plain to you. Chemists are examining the combining-properties of atoms, and getting clear ideas of the constitution of matter.

Admitting, then, for the present, that such is the meaning of chemical work, we have to consider the more important question of its use; and I think you will agree with me that, in order to judge soundly whether and in what manner such a pursuit is useful, we have to consider its effect upon Man. What habits of mind does it engender? What powers does it develop? Does it develop good and noble qualities and aspirations, and tend

to make men more able and more anxious to do good to their fellow men? Or is it a mere idle amusement, bearing no permanent fruits of improvement?

You will, I think, answer these questions yourselves if I can succeed in describing to you some of the chief qualities which experience has shown to be requisite for the successful pursuit of Chemistry, and which are necessarily cultivated by those who qualify themselves for such a career.

One of the first requirements on the part of an investigator is accuracy in observing the phenomena with which he deals. He must not only see the precise particulars of a process as they present themselves to his observation; he must also observe the order in which these particular appearances present themselves under the conditions of each experiment. No less essential is accuracy of memory. An experimental inquirer must remember accurately a number of facts; and he needs to remember their mutual relations, so that one of them when present to his mind may recall those others which ought to be considered with it. In fact he cultivates the habit of remembering facts mainly by their place in Nature. Accuracy in manual operations is required in all experimental inquiries; and many of them afford scope for very considerable skill and dexterity.

These elementary qualities are well known to be requisite for success in experimental science, and to be developed by careful practice of its methods; but some higher qualities are quite as necessary as these in all but the most rudimentary manipulations, and are developed in a remarkable degree by the higher work of science.

Thus it is of importance to notice that a singularly good training in the accurate use of words is afforded by experimental chemistry. Everyone who is about to enter on an inquiry, whether he be a first-year's student who wants to find the constituents of a common salt, or whether he be the most skilled and experienced of chemists, seeks beforehand to get such information from the records of previous observations as may be most useful for his purpose. This information he obtains through the medium of words; and any failure on his part to understand the precise meaning of the words conveying the information requisite for his guidance is liable to lead him astray. Those elementary exercises in analytical chemistry, in which brief directions to the students alternate with their experiments and their reports of experiments made and conclusions drawn, afford a singularly effective training in the habit of attending accurately to the meaning of words used by others, and of selecting words capable of conveying without ambiguity the precise meaning intended. Any inaccuracy in the student's apprehension of the directions given, or in the selection of words to describe his observations and conclusions, is at once detected, when the result to which he ought to have arrived is known beforehand to the teacher.

Accuracy of reasoning is no less effectively promoted by the work of experimental chemistry. It is no small facility to us that the meaning of the words which we use to denote properties of matter and operations can be learnt by actual observation. Moreover, each proposition comprised in chemical reasonings conveys some distinct statement susceptible of verification by similar means; and the validity of each conclusion can be tested, not only by examining whether or not it follows of necessity from true premises, but also by subjecting it to the independent test of special experiment.

Chemists have frequent occasion to employ arguments which indicate a probability of some truth; and the anticipations based upon them serve as guides to experimental inquiry by suggesting crucial tests. But they distinguish most carefully such hypotheses from demonstrated facts.

Thus a pale green solution, stated to contain a pure metallic salt, is found to possess some properties which belong to salts of iron. Nothing else possesses these properties except salts of nickel; and they manifest a slight difference from iron salts in one of the properties observed.

The analyst could not see any appearance of that peculiarity which distinguishes nickel salts; so he concludes that he has probably got iron in his solution, but almost certainly either iron or nickel. He then makes an experiment which will, he knows, give an entirely different result with iron salts and nickel salts; and he gets very distinctly the result which indicates iron.

Having found in the green liquid properties which the presence of iron could alone impart, he considers it highly probable that iron is present. But he does not stop there; for, although the facts before him seem to admit of no other interpretation, he knows that, from insufficient knowledge or attention, mistakes are sometimes made in very simple matters. The analyst therefore tries as many other experiments as are known to distinguish iron salts from all others; and if any one of these leads distinctly to a result at variance with his provisional conclusion, he goes over the whole inquiry again, in order to find where his mistake was. Such inquiries are practised largely by students of chemistry, in order to fix in their minds, by frequent use, a knowledge of the fundamental properties of the common elements, in order to learn by practice the art of making experiments, and, above all, in order to acquire the habit of judging accurately of evidence in natural phenomena. Such a student is often surprised at being told that it is not enough for him to conduct his experiments to such a point that every conclusion except one is contrary to the evidence before him—that he must then try every confirmatory test which he can of the substance believed to be present, and ascertain that the sample in his hands agrees, as far as he can see, in all properties with the known substance of which he believes it to be a specimen.

Those who tread the path of original inquiry, and add to human knowledge by their experiments, are bound to practise this habit with the most scrupulous fidelity and care, or many and grave would be the mistakes they would make.

Thus a chemist thinks it probable that he might prepare some well-known organic body of the aromatic family by a new process. He sets to work and obtains a substance agreeing in appearance, in empirical composition, in molecular weight, and in many other properties with the compound which he had in view. He is, however, not satisfied that his product is a sample of that compound until he has examined carefully whether it possesses all the properties which are known to belong to the substance in question. And many a time is his caution rewarded by the discovery of some distinct difference of melting-point, or of crystalline form, &c., which proves that he has made a new compound isomeric with the one which he expected to make. It seemed probable, from the agreement of the two substances in many particulars, that they might be found to agree in all, and might be considered to be the same compound; but complete proof of that conclusion consists in showing that the new substance agrees with all that we know of the old one.

In the most various ways chemists seek to extend their knowledge of the uniformity of nature; and their reasonings by analogy from particulars to particulars suggest the working hypotheses which lead to new observations. Before, however, proceeding to test the truth of his hypothesis by experiment, the chemist passes in review, as well as he can, all the general knowledge which has any bearing on it, in order to find agreement or disagreement between his hypothesis and the ideas established by past experience. Sometimes he sees that his hypothesis is at variance with some general law in which he has full confidence, and he throws it aside as disproved by that law. On other occasions he finds that it follows of necessity from some known law; and he then proceeds to verify it by experiment, with a confident anticipation of the result. In many cases the hypothesis does not present sufficiently distinct agreement or disagreement with the ideas esta-

blished by previous investigations to justify either the rejection of it or a confident belief in its truth; for it often happens that the results of experience of similar phenomena are not embodied in a sufficiently definite or trustworthy statement to have any other effect than that of giving probability or the contrary to the hypothesis.

Another habit of mind which is indispensable for success in experimental chemistry, and which is taught by the practice of its various operations, is that of truthfulness.

The very object of all our endeavours is to get true ideas of the natural processes of chemical action; for in proportion as our ideas are true do they give us the power of directing these processes. In fact our ideas are useful only so far as they are true; and he must indeed be blind to interest and to duty who could wish to swerve from the path of truth. But if any one were weak enough to make the attempt he would find his way barred by innumerable obstacles.

Every addition to our science is a matter of immediate interest and importance to those who are working in the same direction. They verify in various ways the statements of the first discoverer, and seldom fail to notice further particulars, and to correct any little errors of detail into which he may have fallen. They soon make it a stepping-stone to further discoveries. Anything like wilful misrepresentation is inevitably detected and made known.

It must not, however, be supposed that the investigator drifts unconsciously into the habit of truthfulness for want of temptation to be untruthful, or even that error presents itself to his mind in a grotesque and repulsive garb, so as to enlist from the first his feelings against it; for I can assure you that the precise contrary of these things happens. Error comes before him usually in the very garb of truth, and his utmost skill and attention are needed to decide whether or not it is entitled to retain that garb.

You will easily see how this happens if you reflect that each working hypothesis employed by an investigator is an unproven proposition, which bears such resemblance to truth as to give rise to hopes that it may really be true. The investigator trusts it provisionally to the extent of trying one or more experiments, of which it claims to predict the specific result. Even though it guide him correctly for a while, he considers it still on trial until it has been tested by every process which ingenuity can suggest for the purpose of detecting a fault.

Most errors which an experimentalist has to do with are really imperfect truths, which have done good service in their time by guiding the course of discovery. The great object of scientific work is to replace these imperfect truths by more exact and comprehensive statements of the order of nature.

Whoever has once got knowledge from Nature herself, by truthful reasoning and experiment, must be dull indeed if he does not feel that he has acquired a new and noble power, and if he does not long to exercise it further, and make new conquests from the realm of darkness by the aid of known truths.

The habit of systematically searching for truth by the aid of known truths, and of testing the validity of each step by constant reference to nature, has now been practised for a sufficiently long time to enable us to judge of some of its results.

Every true idea of the order of nature is an instrument of thought. It can only be obtained by truthful investigation, and it can only be used effectively in obedience to the same laws. But the first idea which is formed of anything occurring in nature affords only a partial representation of the actual reality, by recording what is seen of it from a particular point of view. By examining a thing from different points of view we get different ideas of it; and when we compare these ideas accurately with one another, recollecting how each one was obtained, we find that they really supplement each other,

We try to form in our minds a distinct image of a thing capable of producing these various appearances; and when we have succeeded in doing so, we look at it from the different points of view from which the natural object had been examined, and find that the ideas so obtained meet at the central image. It usually happens that an accurate examination of the mutual bearings of these ideas on the central image suggests additions to them, and correction of some particulars in them.

Thus it is that true ideas of a natural phenomenon confirm and strengthen one another, and he who aids directly the development of one of them is sure to promote indirectly the consolidation of others.

Each onward step in the search for truth has made us stronger for the work; and when we look back upon what has been done by the efforts of so many workers simply but steadily directed by truth towards further truth, we see that they have achieved, for the benefit of the human race, the conquest of a systematic body of truths which encourages men to similar efforts while affording them the most effectual aid and guidance.

This lesson of the inherent vitality of truth, which is taught us so clearly by the history of our science, is well worthy of the consideration of those who, seeing that iniquity and falsehood so frequently triumph for a while in the struggle for existence, are inclined to take a desponding view of human affairs, and almost to despair of the ultimate predominance of truth and goodness. I believe it would be impossible, at the present time, to form an adequate idea of the vast consequences which will follow from the national adoption of systematic measures for allowing our knowledge of truth to develop itself freely, through the labours of those who are willing and able to devote themselves to its service, so as to strengthen more and more the belief and trust of mankind in its guidance, in small matters as well as in the highest and most important considerations.

I am desirous of describing briefly the more important of those measures; but first let me mention another habit of mind which naturally follows from the effective pursuit of truth,—a habit which might be described in general terms as the application to other matters of the truthfulness imparted by science.

The words which the great German poet put into the mouth of Mephistopheles, when describing himself to Faust, afford perhaps the most concise and forcible statement of what we may call the anti-scientific spirit:—

> "Ich bin der Geist der stets verneint,
> Dem alles, was entsteht, zuwider ist."

The true spirit of science is certainly affirmative, not negative, for, as I mentioned just now, its history teaches us that the development of our knowledge usually takes place through two or more simultaneous ideas of the same phenomenon, quite different from one another, both of which ultimately prove to be parts of some more general truth; so that a confident belief in one of those ideas does not involve or justify a denial of the others.

I could give you many remarkable illustrations of this law from among ideas familiar to chemists. But I want you to consider with me its bearing on the habit of mind called toleration, of which the development in modern times is perhaps one of the most hopeful indications of moral improvement in man.

In working at our science we simply try to find out what is true; for although no usefulness is to be found at first in most of our results, we know well that every extension of our knowledge of truth is sure to prove useful in manifold ways. So regular an attendant is usefulness upon truth in our work, that we get accustomed to expect them always to go together, and to believe that there must be some amount of truth wherever there is manifest usefulness.

The history of human ideas, so far as it is written in the records of the progress of science, abounds with instances of men contributing powerfully to the development of important general ideas, by their accurate and conscientious experiments, while at the same time pro-

fessing an actual disbelief in those ideas. Those records must indeed have been a dead letter to any who could stand carping at the intellectual crotchets of a good and honest worker, instead of giving him all brotherly help in the furtherance of his work.

To one who knows the particulars of our science thoroughly, and who knows also what a variety of ideas have been resorted to in working out the whole body of truths of which the science is composed, there are few more impressive and elevating subjects of contemplation than the unity in the clear and bold outline of that noble structure.

I hope that you will not suppose, from my references to Chemistry as promoting the development of these habits and powers of mind, that I wish to claim for that particular branch of science any exclusive merit of the kind, for I can assure you that nothing can be further from my intention.

I conceived that you would wish me to speak of that department of science which I have had occasion to study more particularly; but much that I have said of it might be said with equal truth of other studies, while some of its merits may be claimed in a higher degree by other branches of science. On the other hand, those highest lessons which I have illustrated by chemistry are best learnt by those whose intellectual horizon includes other provinces of knowledge.

Chemistry presents peculiar advantages for educational purposes in the combination of breadth and accuracy in the training which it affords; and I am inclined to think that in this respect it is at present unequalled. There is reason to believe that it will play an important part in general education, and render valuable services to it in conjunction with other scientific and with literary studies.

(To be continued.)

Section B.

ADDRESS

TO THE

CHEMICAL SECTION.

SEPTEMBER 18, 1873.

By W. J. RUSSELL, Ph.D., F.R.S.,
President of the Section.

LADIES AND GENTLEMEN,—

OF late years it has been the custom of my predecessors in this chair to open the business of the Section with an address, and the subject of this address has almost invariably been a review of the progress of Chemistry during the past year: I purpose, with your leave, to-day to deviate somewhat from this precedent, and to limit my remarks, as far as the progress of Chemistry is concerned, to the history of one chemical substance. The interest and the use of an annual survey at these meetings of the progress of Chemistry has to a certain extent passed away; for the admirable abstracts of all important chemical papers now published by the Chemical Society has, in a great measure, taken its place, and offers to the chemical student a much more thorough means of learning what progress his science is making than could possibly be done by the study of a presidential address. Doubtless these abstracts of chemical papers are known to others than professional chemists; but I cannot pass them over without recording the great use they have proved to be, how much they have done already in extending in this country an exact knowledge of the progress of science on the Continent, and in helping and in stimulating those who are engaged in scientific pursuits in this country. I believe few grants made by this Association have done more real good than those which have enabled the Chemical Society to publish these abstracts.

I dwell for a moment on the doings of the Chemical Society, for I believe in the progress of this Society we have a most important indication of the progress of chemical science in this country. The number of original papers communicated to the Society during the last year has far exceeded that of previous years; during last year fifty-eight papers were read to the Society, whereas the average number for the last three years is only twenty-nine. Further, I may say there is every appearance of this increased activity not only continuing but even increasing. Another matter connected with the Society deserves a passing word: I mean its removal from its old rooms at Burlington House, which afforded it very insufficient accommodation, to its new ones in the same building. This transference, which is now taking place, will give to the Society a great increase of accommodation, and thus admit of larger audiences attending the lectures, of the proper development of the library, and of the full illustration, by experiment, of the communications made to it. These improvements must act most beneficially on the Society, and stimulate its future development: even now it numbers some 700 members, and certainly is not one of the least active or least useful of the many scientific societies in London.

Since our last Meeting at Brighton we have lost the most renowned of modern chemists, Liebig. His influence on chemistry through a long and most active life has yet to be written. Publishing his first paper fifty years ago, it is difficult for chemists of the present day to realise the changes in chemical thought, in chemical knowledge, and in chemical experiment which he lived through, and was, more than any other chemist, active in promoting. His activity was unwearied; he communicated no less than 317 papers to different scientific journals, and almost every branch of chemistry received some impetus from his hand.

Liebig took an active interest in this Association, and I believe the last paper he wrote was one in answer to a communication made at the last Meeting of this Association. On two occasions he attended Meetings of the British Association, and has communicated many papers to this Section. The Meeting at Liverpool in 1837 was the first at which he was present; he then communicated to this Section a paper on the products of the decomposition of Uric Acid, and, further, gave an account of his most important discovery, made in conjunction with Wöhler, of the artificial formation of Urea. At this Meeting Liebig was requested to prepare a report on the state of our knowledge of isomeric bodies. This request, although often repeated, was never complied with. He was also requested to report on the state of Organic Chemistry and Organic Analysis: thus our Section was evidently desirous of giving him full occupation. At the Meeting in 1840, at Glasgow, a paper on Poisons, Contagions, and Miasms, by Liebig, was read; it was, in fact, an abstract of the last chapter in his book on Chemistry in its applications to Agriculture and Physiology; and the work itself appeared about the same time, dedicated to this Association. In his dedication Liebig says:—"At one of the meetings of the Chemical Section of the British Association for the Advancement of Science, the honourable task of preparing a Report upon the State of Organic Chemistry was imposed upon me. In this present work I present the Association with a part of this Report."

At the next Meeting, which was at Plymouth, in 1841, there was an interesting letter from Liebig to Dr. Playfair, read to our Section; in it, among other matters, Liebig describes an "excellent method," devised by Drs. Will and Varrentrapp, for determining the amount of nitrogen in organic bodies: he also says we have repeated all the experiments of Dr. Brown on the production of silicon from paracyanogen, but we have not been able to confirm one of his results; what our experiments prove is, that paracyanogen is decomposed by a strong heat into nitrogen gas and a residue of carbon, which is exceedingly difficult of combustion.

To the next Meeting (which was at Manchester, and

Dalton was the President of this Section) Dr. Playfair communicated an abstract of Prof. Liebig's report on Organic Chemistry applied to Physiology and Pathology: this abstract is printed in our *Proceedings*, and the complete work is looked upon as the second part of the report on Organic Chemistry. This Association may therefore fairly consider that it exercised some influence on Liebig in the production of the most important works that he wrote. Playfair's abstract must have been listened to with the greatest interest, and I doubt not the statements made were sharply criticised, especially by the physiologists then at Manchester. Playfair concludes his abstract in these words, thus summing up the special objects of these reports:—"In the opinion of all, Liebig may be considered a benefactor to his species for the interesting discoveries in agriculture published by him in the first part of this report. And having in that pointed out means by which the food of the human race may be increased, in the work now before us he follows up the chain in its continuation, and shows how that food may best be adapted to the nutrition of man. Surely there are no two subjects more fitted than these for the contemplation of the philosopher; and by the consummate sagacity with which Liebig has applied to their elucidation the powers of his mind, we are compelled to admit that there is no living philosopher to whom the Chemical Section could have more appropiately entrusted their investigation."

At the Meeting at Glasgow in 1855 Liebig was also present, but he then only communicated to this Section a short paper on fulminuric acid, and some remarks on the use of lime-water in the manufacture of bread.

Such, I believe, is the history of the direct relationship which has existed between Liebig and this Association. Indirectly we can hardly recognise how much we owe to him. Interested as he ever was in the work of this Association, I could not but to-day record the instances of direct aid and support which this Section has received from him.

I pass on now to the special subject to which I wish to ask your attention. It is the history of the vegetable colouring matter found in madder: it has been in use from time immemorial. and is still one of the commonest and most important of dyes: it is obtained from a plant largely cultivated in many parts of the world for the sake of the colour it yields; and the special interest which now attaches to it is that the chemist has lately shown how this natural colouring matter can be made in the laboratory as well as in the fields—how by using a by-product which formerly was without value, thousands of acres can be liberated for the cultivation of other crops, and the colouring matter which they formerly produced be cheaper and better prepared in the laboratory or in the manufactory. That a certain colouring matter could be obtained from the roots of the *Rubia tinctorum* and other species of the same plant has been so long known that apparently no record of its discovery remains. Pliny and Dioscorides evidently allude to it. The former, referring to its value as a dyeing material, says—"It is a plant little known, except to the sordid and avaricious; and this because of the large profits obtained from it, owing to its employment in dyeing wool and leather." He further says—"The madder of Italy is the most esteemed, and especially that grown in the neighbourhood of Rome, where and in other places it is produced in great abundance." He further describes it as being grown among the olive-trees, or in fields devoted especially to its growth. The madder of Ravenna, according to Dioscorides, was the most esteemed. Its cultivation in Italy has been continued till the present time, and in 1863 the Neapolitan provinces alone exported it to the value of more than a quarter of a million sterling. At the present day we are all very familiar with this colouring matter as the commonest that is applied to calicoes: it is capable of yielding many colours, such as red, pink, purple, chocolate, and black. The plant which is the source of this colouring matter is nearly allied, botanically and in appearance, to the ordinary *Galiums* or bedstraws. It is a native probably of Southern Europe, as well as Asia. It is a perennial, with herbaceous stem, which dies down every year; its square-jointed stalk creeps along the ground to a considerable distance, and the stem and leaves are rough, with sharp prickles. The root, which is cylindrical, fleshy, and of a pale yellow colour, extends downwards to a considerable depth: it is from this root (which, when dried, is known as madder) that the colouring matter is obtained. The plant is propagated from suckers or shoots; these require some two or three years to come to full maturity and yield the finest colours, although in France the crop is often gathered after only eighteen months' growth. From its taking so long to develop, it is evidently a crop not adapted to any ordinary series of rotation of crops. The plant thrives best in a warm climate, but has been grown in this country and in the north of Europe.

In India it has been grown from the earliest times, and, as before stated, has been abundantly cultivated in Italy certainly since the time of Pliny; he also mentions its cultivation in Galilee. In this country its culture has often been attempted, and has been carried on for a short time, but never with permanent success. The madder now used in England is imported from France, Italy, Holland, South Germany, Turkey, and India. In 1857 the total amount imported into this country was 434,056 cwts., having an estimated value of £1,284,989; and the average annual amount imported during the last seventeen years is 310,042 cwts., while the amount imported last year (1872) was 283,274 cwts., valued at £922,244. In 1861 it was estimated that in the South Lancashire district alone 150 tons of madder were used weekly, exclusive of that required for preparing garancin, I quote these figures as showing the magnitude of the industry that we are dealing with. Another point of much interest is the amount of land required for the cultivation of this plant: in England it was found that an acre yielded only from 10 to 20 cwts. of the dried roots, but in South Germany and in France the same amount of land yields about twice that quantity. The madder cultivator digs up the roots in autumn, dries them, in some cases peels them by beating them with a flail, and exports them in the form of powder, whole root, or after treatment with sulphuric acid, when it is known as garancin.

The quality of the root varies much; that from the Levant, and known as Turkey-root, is most valued. According, however, to the colour to be produced is the madder from one source or another preferred. To obtain the colouring matter, which is but very slightly soluble in water, from these roots, they are mixed, after being ground, with water in the dye-vessel, and sometimes a little chalk is added. The fabric to be dyed is introduced, and the whole slowly heated; the colouring matter gradually passes from the root to the water, and from the water to the mordanted fabric, giving to it a colour dependent of course on the nature of the mordant.

To trace the chemical history of this colouring matter we have to go back to the year 1790, when a chemist of the name of Watt precipitated the colouring matter of madder by alum from neutral, alkaline, and acid solutions; he obtained two different colouring matters, but could not isolate them, and many different shades of colour. Charles Batholdi asserted that madder contained much magnesic sulphate, and Hausmann observed the good effect produced on madder by the addition of calcic carbonate. In 1823 F. Kuhlmann made evidently a careful analysis of the madder root, and describes a red and a fawn colouring matter; but the first really important advance made in our knowledge of the chemical constitution of this colouring matter was by Colin and Robiquet in 1827; they obtained what they believed to be, and what has since really proved to be, the true colouring principle of madder, and obtained it in a state of tolerable purity. Their process for preparing it was very simple: they took Alsace madder in powder, digested it with water, obtained thus a gelatinous mass,

which they treated with boiling alcohol, then evaporated off four-fifths of the alcohol, and treated the residue with a little sulphuric acid to diminish its solubility; then, after washing it with several litres of water, they got a yellowish substance remaining. Lastly, they found that, on moderately heating this product in a glass tube, they obtained a yellowish vapour formed of brilliant particles, which condensed, giving a distinct zone of brilliant needles, reflecting a colour similar to that from the native lead chromate. They named this substance alizarin, from the Levant name for madder, *alizari*, the name by which it is still known there.

A few years later we find other chemists attacking this same subject. In 1831, Gaultier de Claubry and J. Persoz published the account of a long research on the subject; they describe two colouring matters, a red and a rose one: the red one was alizarin, and the rose one was another body nearly allied to it, and now well-known as purpurin. Runge also made an elaborate examination of the madder-root; he found no less than five different colouring matters in it—madder-red, madder-purple, madder-orange, madder-yellow, and madder-brown. The first three he considers to be suited for dyeing purposes, but not so the last two. Runge's madder-red is essentially impure alizarin, and his madder-purple impure purpurin. He does not give any analysis of these substances.

During the next ten years this subject seems to have attracted but little attention from chemists; but in 1846 Shiel prepared the madder-red and madder-purple of Runge by processes very similar to those employed by Runge, and analysed these substances: for madder-red he gives the formula $C_{28}H_{18}O_9$, which differs only by H_2O from the formula now adopted; for the madder-purple he gives the formula $C_{28}H_{20}O_{15}$, and for the same substance after being sublimed $C_2H_8O_4$. The chemist who has worked most on this subject, and to whom we are principally indebted for what we know with regard to the different constituents contained in the madder-root, is Dr. Schunck, of Manchester. In Liebig's "Annalen" for 1848 he gives a long and interesting account of his examination of madder; he isolates and identifies several new substances, which are most important constituents of the root, and has since that time added much to our knowledge of the chemical constitution of madder. In the paper above alluded to he confirms the presence of the alizarin, and gives to it the formula $C_{14}H_{10}O_4$. The principal properties of this body may best be sketched in here. Its volatility and brilliant crystalline appearance have already been mentioned; it is but slightly soluble in cold water, but much more so in alcohol, in ether, and in boiling water. The colour of its solution is yellow; and when it separates out from a liquid it has a yellow flocculent appearance, differing thus greatly from the red brilliant crystalline substance before described. In order to obtain this latter body, heat had always been used; so, until the elaborate experiments of Schunck, it was a question whether the heat did not produce a radical change in the substance, whether, in a word, these two bodies were really identical. Schunck's experiments proved that they were, and consequently that this beautiful colouring matter, alizarin, existed as such in madder. If, however, we go one step further back, and examine the fresh root of the *Rubia tinctorum* (that is, as soon as it is drawn from the ground), we shall find no trace of alizarin there. On slicing the root it is seen to be of a light carrotty colour, and an almost colourless liquid can be squeezed out of it; but this is entirely free from the colouring matters of madder. Let the roots, however, be kept, if only for a short time, and then they will give abundant evidence of the presence of alizarin; if simply heated, alizarin may be volatilised from them. It appears, then, that the whole of the tinctorial power of this root is developed after the death of the plant. Schunck explains this curious phenomenon as follows:—In the cells of the living plant there is a substance which he has isolated and has named rubian; it is easily soluble in water and in alcohol; the solution is of a yellow colour, and has an intensely bitter taste; when dry, it is a hard brown gum-like body. It has none of the properties of a dye-stuff; but if we take a solution of it, add some sulphuric or hydrochloric acid to it, and boil, a yellow flocculent substance will slowly separate out, and, on filtering it off and washing it, it will be found to have the tinctorial properties of madder, and to contain alizarin. In the liquid filtered from it there is, with the acid added, an uncrystallisable sugar; so that in this way the original product in the root, the rubian, has apparently been split up into alizarin and into sugar. To apply this reaction to what goes on in the root after its removal from the ground, we have to find if any other substances can take the place of the boiling dilute acid; and Schunck has shown there exists in the root itself a substance which is eminently fitted to produce this splitting-up of the rubian. He obtained this decomposing agent from madder simply by digesting it in cold water and adding alcohol to the liquid; this threw down a reddish flocculent substance; and, if only a small portion of this was added to an aqueous solution of the rubian, and allowed to stand for a few hours in a warm place, it was found that the rubian was gone, and in place of it there was a thick tenacious jelly; this, treated with cold water, gave to it no colour, no bitter taste, but much sugar. From the jelly remaining insoluble, alizarin could be extracted; in fact, of all known substances this very one found in the madder itself is best suited for effecting this decomposition of the rubian.

It has long been known to dyers that the amount of colouring matter in madder will increase on keeping it; even for years it will go on improving in quality: and an experiment of Schunck's shows that the ordinary madder, as used by the dyer, has not all the rubian converted into colouring matter; for, on taking a sample of it and extracting it with cold water, he got an acid solution devoid of dyeing properties; but, on allowing this solution to stand some time, it gelatinised, and then possessed dyeing properties.

It appears, then, that there must exist in the root two substances kept apart during the life of the plant in some way of which we know nothing; but as soon as it dies they begin slowly to act on one another, developing thus the colouring matters in madder.

Coincident with the appearance of Schunck's first paper was one by Debus on the same subject: he looked upon alizarin as a true acid, and gave it the name of lizaric acid; but, as far as the composition of it was concerned, the percentage numbers he obtained agreed closely with those given by Schunck. One other investigation concludes all that is important in the history of alizarin as obtained from madder. This last investigation is of great interest; it was by Julius Wolff and Adolphe Strecker, and published in 1850; they confirm the results of others so far that there are in the madder-root two distinct colouring substances—this important one alizarin, and the other one purpurin. They prepare these colouring matters much in the same way that Schunck did, and very carefully purify and analyse them: the formulæ which they give for them differ, however, from Schunck's; for alizarin they give the formula $C_{20}H_{12}O_6$, and for purpurin $C_{18}H_{12}O_6$. Further, they suggest that, by the process of fermentation, the former is converted into the latter, and they show that by oxidation they both yielded phthalic acid. Since the publication of this research, until the last year or two, this formula for alizarin has been generally adopted by chemists, and in most modern books we find it given as expressing the true composition of that body. It was not only the careful and elaborate work which they devoted to the subject, but also the ingenious and apparently well-founded theory on the subject, which carried conviction with it. Laurent had shown, not many years before, that when naphthalin, that beautiful and white crystalline substance obtained from coal-tar, was acted on by chlorine, and then treated with nitric acid, a body, known as chlornaphthalic acid, and having the composition

$C_{20}H_{10}Cl_2O_6$, was obtained; and, on comparing this formula with the one they had obtained for alizarin, Wolff and Strecker at once concluded that it really was alizarin, only containing 2 atoms of chlorine in place of 2 of hydrogen; make this replacement, an operation generally easily performed, and from naphthalin they had prepared alizarin. Further, this relationship between chlornaphthalic acid and alizarin is borne out in many ways; it, like alizarin, has the power of combining with different basic substances, has a yellow colour, is insoluble in water, melts at about the same temperature, is volatile, and when acted on by alkalies gives a stronglycoloured solution. Taking, then, all these facts into consideration, can we wonder that these chemists feel convinced that they have established the composition of alizarin, and have shown the source from which it is to be obtained artificially? Apparently but one very simple step remains to crown their work with success, that of replacing the chlorine by hydrogen. Melsens had only shortly before shown how this substitution could easily be made in the case of chloracetic acid, by acting on it with potassium amalgam; and Kolbe had used the battery for the same purpose: both these processes, and doubtless all others that the authors can think of, are tried upon the chlornaphthalic acid; but chlornaphthalic acid it remains, and they are obliged to confess they are unable to make this substitution; still they are strong in the belief that it is to be done and will be done, and conclude the account of their researches by pointing out the great technical advantage it will be getting alizarin from a worthless substance such as naphthalin. One cannot help even now sympathising with these chemists in their not being able to confirm what they had really the strongest evidence for believing must prove to be a great discovery. We now know, however, that had they succeeded in effecting this substitution, or had they in any other way obtained this chlornaphthalic acid without the chlorine, if I may so speak of it, which since their time has been done by Martius and Griess, alizarin would not have been obtained, but a body having a remarkable parallelism in properties to it would have been. This body, like alizarin, is of a yellowish colour, but slightly soluble in water, easily in alcohol and in ether, is volatile, and on oxidation yields the same products; it is, in fact, an analogous body, but belonging to another group. We also now know that the formula proposed by Wolff and Strecker, and so long in use, is not the correct one. But little more remains to be added with regard to the history of alizarin, as gathered from the study of the natural substance. Schützenberger and Paraf suggested doubling Wolff and Strecker's formula for alizarin; and Bolley suggested the formula $C_{20}H_{13}O_6$, which, owing to the uneven number of hydrogen atoms, was soon rejected. If we compare our present knowledge of alizarin with what it was when these researches on the natural product were completed, it is as lightness compared to darkness; and we may well ask, whence has come this influx of knowledge? The answer, I hope to show you, is undoubtedly that it has come from the careful and accurate study of abstract chemistry. I know of no history in the whole of chemistry which more strikingly illustrates how the prosecution of abstract science lays the foundation for great practical improvements than the history of alizarin does.

My object now is, then, to show you, as shortly as I can, how by indirect means the composition of alizarin was discovered, how it has been built up artificially, and how it is superseding for manufacturing purposes the long-used natural product.

To trace this history from its source we must go back to 1785, when an apothecary of the name of Hofmann obtained the calcium salt of an acid called quinic acid from Cinchona bark. This acid is now known to be of common occurrence in plants; it exists in the bilberry and in coffee, in holly, ivy, oak, elm, and ash leaves, and probably many other leaves. Liebig also prepared the calcium salt, and was the first to give a complete analysis of it; the formula he gave for it was $C_{15}H_{24}O_{12}$. Baup, on repeating Liebig's experiments, arrived at a somewhat different conclusion, and gave the formula $C_{15}H_{20}O_{10}$. In 1835, at Liebig's seggestion to determine which formula was correct, Alexander Woskrensky, from St. Petersburg, then a student at Giessen, undertook the further investigation of this subject, and established the formula $C_{14}H_{24}O_{12}$, the one in fact now in use. In the course of this investigation, which he carried further than merely settling the percentage composition of this acid, he describes what to us now is of most interest, a new substance having peculiar and very marked properties. He says that when a salt of quinic acid is burnt at a gentle heat he gets aqueous vapour, the vapour of formic acid, and a deposit of golden needles, which are easily sublimed; afterwards he describes how this same golden substance may be obtained from any salt of quinic acid by heating it with manganic dioxide and dilute sulphuric acid; it then distils over, condensing in golden-yellow needles on the sides of the receiver, and may be rendered pure by resublimation. The composition of this body he finds to be C_3H_2O, and names it quinoyl, a name strongly objected to by Berzelius, as conveying a wrong impression of the nature of the body; he proposed in place of it the name quinone, by which it is still known. Far as this body would seem to be removed from alizarin, yet it is the study of its properties which led to the artificial production of alizarin.

Some years afterwards Wöhler also examined the decomposition of quinic acid; he prepares again this quinone, and follows exactly the process described by Woskrensky: he states that, with regard to the properties of this remarkable body, he has nothing particular to add; however, he proposes a different formula for it, and discovers and describes other bodies allied to it; among these is hydroquinone, $C_6H_6O_2$. Laurent afterwards shows that the formula proposed by Wöhler is inconsistent with his and Gerhardt's views, and by experiment confirms the former formula for this body. Although many other chemists devoted much attention to this substance, still its real constitution and relation to other compounds remained long unknown. Thus Wöhler, Laurent, Hofmann, Städeler, and Hesse all had worked at it, and much experimental knowledge with regard to it had been acquired. One important point in its history was, first, the discovery of chloranil by Erdmann in 1841, and then Hofmann showing that by heating quinone with potassic chlorate and hydrochloric acid, chloranil could be obtained from it—that, in fact, chloranil was quinone in which all the hydrogen had been replaced by chlorine. Perhaps the most general impression among chemists was, that in constitution it was a kind of aldehyd; certainly its definite place among chemical compounds was not known. Kekulé suggests a rational formula for it; but it is to Carl Græbe that we owe our knowledge of its true constitution. In 1868 he published a remarkable and very able paper on the quinone group of compounds, and then first brought forward the view that quinone was a substitution derivative of the hydrocarbon benzol (C_6H_6). On comparing the composition of these two bodies, it is seen that the quinone contains 2 atoms of oxygen more, and 2 atoms of hydrogen less, than benzol; and Græbe, from the study of the decomposition of quinone and from the compounds it forms, suggested that the 2 atoms of oxygen form in themselves a group which is divalent, and thus replace the two atoms of hydrogen; this supposition he very forcibly advocates, and shows its simple and satisfactory application to all the then known reactions of this body. This suggestion really proved to be the key, not only to the explanation of the natural constitution of quinone and its derivatives, but to much important discovery besides.

At this time quinone seemed to stand alone, no other similarly constituted body was known to exist; but what strikingly confirms the correctness of Græbe's views, and indicates their great value, is that immediately he is able

to apply his lately gained knowledge, and to show how really other analogous bodies, other quinones in fact, already exist. He studied with great care this quinone series of compounds and the relation they bore to one another—the relation the hydrocarbon benzol bore to its oxidised derivative quinone, and its relation to the chlorine substitution-products derivable from it. At once this seems to have led Græbe to the conclusion that another such series already existed ready formed, and that its members were well known to chemists—that, in fact, naphthalin ($C_{10}H_8$) was the parent hydrocarbon, and that the chloroxynaphthalin chloride ($C_{10}H_4Cl_2O_2$) and the perchloroxynaphthalin chloride ($C_{10}Cl_6O_2$) were really chlorine substitution-compounds of the quinone of this series, corresponding to the bichloroquinone and to chloranil—that the chloroxynaphthalic acid, $C_{10}H_4Cl(HO)O_2$, and the perchloroxynaphthalic acid, $C_{10}Cl_5(HO)O_2$, all compounds previously discovered by Laurent, were really bodies belonging to this series—and, further, that the supposed isomer of alizarin discovered by Martius and Griess was really related to this last compound, having the composition $C_{10}H_5(HO)O_2$. Further, he was able to confirm this by obtaining the quinone itself of this series, the body having the formula $C_{10}H_6(O_2)''$, containing also 2 atoms less of hydrogen and 2 atoms more of oxygen than the hydrocarbon naphthalin; and to this body he gave the characteristic name of naphthoquinone. The chlorine compounds just named are, then, chlornaphthoquinones or chloroxynaphthoquinones, and correspond to the former chloroquinones; and Martius and Griess's compound will be an oxynaphthoquinone: many other compounds of this series are also known. Another step confirmatory of this existence of a series of quinones was made by Græbe and Bergmann: as the chloranil could be found by treating phenol with potassic chlorate and hydrochloric acid, and quinone derived from it, they showed that in the next higher series to the phenol series, viz., with cresol, the same reaction held good; and by treating it in the same way, they obtained a di- and a trichlorotoluquinone—

$$C_6\begin{Bmatrix}CH_3\\(O_2)''\\Cl_2\\H\end{Bmatrix}, \qquad C_6\begin{Bmatrix}CH_3\\(O_2)''\\Cl_3\end{Bmatrix},$$

which in physical properties very closely resembled the corresponding compounds in the lower series: other compounds have also been prepared.

In the next step we have the application which connects these series of discoveries with alizarin. Following the clue of a certain analogy which they believed to exist between the chloranilic acid—

$$\left\{C_6Cl_2\begin{matrix}(O_2)''\\(HO)_2\end{matrix}\right\}$$

and the chloroxynaphthalic acid—

$$\left\{C_{10}H_4Cl\begin{matrix}(O_2)''\\HO\end{matrix}\right\},$$

which they had proved to be quinone compounds and alizarin, believing that a certain similarity of properties indicated a certain similarity of constitution, Græbe and Liebermann were led to suppose that alizarin must also be a derivative from a quinone, and have the formula—

$$\left\{C_{14}H_4\begin{matrix}(O)_2\\(HO)_2\end{matrix}\right\}.$$

This theory they were able afterwards to prove. The first thing was to find the hydrocarbon from which the quinone might be derived. This was done by taking alizarin itself and heating it with a very large excess of zinc powder in a long tube closed at one end. A product distilled over, and condensed in the cool part of the tube. On collecting it and purifying it by re-crystallisation, they found they had not a new substance, but a hydrocarbon discovered as long ago as 1832 by Dumas and Laurent, and obtained by them from tar. They had given it the formula $C_{15}H_{12}$; and as apparently it thus contained once and a half as many atoms of carbon and hydrogen as naphthalin did, they named it paranaphthalin. Afterwards Laurent changed its name to anthracen, by which it is still known. Fritzche, in 1857, probably obtained the same body, but gave it the formula $C_{14}H_{10}$. Anderson also met with it in his researches, established its composition, and formed some derivatives from it. Limprich in 1866 showed it could be formed synthetically by heating benzol chloride (C_7H_7Cl) with water; and Berthelot has since proved that it is formed by the action of heat on many hydrocarbons. This first step was then complete and most satisfactory; from alizarin they had obtained its hydrocarbon, and this hydrocarbon was a body already known, and with such marked properties that it was easy to identify it. But would the next requirement be fulfilled? would it, like benzol and naphthalin, yield a quinone? The experiment had not to be tried; for when they found that anthracen was the hydrocarbon formed, they recognised in a body already known the quinone derivable from it. It had been prepared by Laurent by the action of nitric acid on anthracen, and called by him Anthracenuse; and the same substance was also discovered by Anderson, and called by him Oxanthracen. The composition of this body was proved by Anderson and Laurent to be $C_{14}H_8O_2$, and thus bears the same relation to its hydrocarbon anthracen that quinone and naphthaquinone do to their hydrocarbons. Græbe gave to it the systematic name of Anthraquinone.

We have then now three hydrocarbons—C_6H_6, $C_{10}H_8$, and $C_{14}H_{10}$—differing by C_4H_2, and all forming starting-points for these different quinone series. Anthraquinone, acted upon by chlorine, gave substitution-products such as might have been foretold. It is an exceedingly stable compound, not acted upon even by fusion with potassic hydrate. Bromine does not act upon it in the cold, but at 100° it forms a bibromanthraquinone. Other bromine compounds have also been formed.

Now, if the analogies which have guided them so far still hold good, they would seem to have the means of forming alizarin artificially. Their theory is that it is dioxyanthraquinone—

$$\left\{C_{14}H_6\begin{matrix}(O_2)''\\(HO)_2\end{matrix}\right\}$$

and if so, judging from what is known to take place with other quinone derivatives, should be formed from this dibromanthraquinone on boiling it with potash or soda and then acidulating the solution. They try the experiment, and describe how, contrary at first to their expectation, on boiling dibromanthraquinone with potash no change occurred; but afterwards, on using stronger potash and a higher temperature, they had the satisfaction of seeing the liquid little by little become of a violet colour. This shows the formation of alizarin. Afterwards, on acidifying this solution, the alizarin separated out in yellowish flocks. On volatilising it they get it in crystals like those obtained from madder; on oxidising it with nitric acid, they get phthalic acid; and on precipitating it with the ordinary mordants or other metallic solutions, they get compounds exactly comparable to those from the natural product. Every trial confirms their success; so, by following purely theoretical considerations, they have been led to the discovery of the means of artificially forming this important organic colouring matter. A special interest must always attach itself to this discovery, for it is the first instance in which a natural organic colouring matter has been built up by artificial means. Now the chemist can compete with nature in its production. Although the first, it is a safe prediction that it will not long be the only one. Which colouring matter will follow next it is impossible to say; but, sooner or later, that most interesting one, scientifically and practically indigo, will have to yield to the scientific chemist the history of its production.

Returning for a moment to the percentage composition of alizarin, now that we know its constitution, its formula is established; and on comparing it ($C_{14}H_8O_4$) with all the different formulæ which have been proposed, we see

that the one advocated by Schunck was most nearly correct—in fact, that it differs from it only by 2 atoms of hydrogen. It is not without interest to note that the next most important colouring matter in madder, purpurin, which so pertinaciously follows alizarin, is in constitution very nearly allied to it, and is also an anthracen derivative.

Scientifically, then, the artificial production of this natural product was complete; but the practical question, Can it be made in the laboratory cheaper than it can be obtained from the root? had yet to be dealt with. The raw material, the anthracen, a by-product in the manufacture of coal-gas, had as yet only been obtained as a chemical curiosity; it had no market value; its cost would depend on the labour of separating it from the tar and the amount obtainable. But with regard to the bromine necessary to form the bibromanthraquinone it was different; the use of such an expensive reagent would preclude the process becoming a manufacturing one. But could no cheaper reagent be used in place of the bromine, and thus crown this discovery by utilising it as a manufacturing process? It was our countryman Mr. Perkin who first showed how this could be done, and has since proved the very practical and important nature of his discovery by carrying it out on the manufacturing scale. The nature of Perkin's discovery was the forming, in place of a bibromanthraquinone, a disulphoanthraquinone; in a word, he used sulphuric acid in place of bromine, obtaining thus a sulpho-acid in place of a bromine substitution-compound. The properties of these sulpho-acids, containing the monovalent group HSO_3, which is the equivalent to the atom of bromine, is that on being boiled with an alkali they are decomposed, and a corresponding alkaline salt formed. Thus the change from the anthraquinone to the alizarin was effected by boiling it with sulphuric acid. At a high temperature it dissolves, becoming a sulpho-acid—

$$C_{14}H_6\begin{cases}(O_2)''\\HSO_3;\\HSO_3\end{cases}$$

and then the further changes follow, as they did with the bromine compound. The sulpho-acid boiled with potash is decomposed, and a potash salt of alizarin and potassic sulphite are formed; acid then precipitates the alizarin as a bright yellow substance.

While Perkin was carrying on these researches in this country, Caro, Græbe, and Liebermann were carrying on somewhat similar ones in Germany; and in both countries have the scientific experiments developed into manufacturing industries. My knowledge extends only to the English manufactory; and if any excuse be necessary for having asked your attention to-day to this long history of a single substance, I think I must plead the existence of that manufactory as my excuse; for it is not often that purely scientific research so rapidly culminates in great practical undertakings. Already has the artificial become a most formidable opponent to the natural product; and in this struggle, already begun, there can be no doubt which will come off victorious.

In the manufactory is rigidly carried out the exact process I have already described to you. In tar there is about 1 per cent of anthracen; this, in a crude impure state, is obtained from it by the tar-distiller and sent by him to the colour works. Here it is purified by pressure, by dissolving from it many of its impurities, and, lastly, by volatilising it. Then comes the conversion of it into the anthraquinone by oxidising agents, nitric or chromic acid being used, then the formation of the sulpho-compound by heating it with sulphuric acid to a temperature of about 260° C. The excess of acid present is then neutralised by the addition of lime, and the insoluble calcic sulphate is filtered off. To the filtered liquid sodic carbonate is added, and thus the calcic salt of the sulpho-acid is changed into the sodic salt—

$$C_{14}H_6\begin{cases}(O_2)''\\NaSO_3.\\NaSO_3\end{cases}$$

This is afterwards heated to about 180° C. with caustic soda, thus decomposing the sulpho-acid and forming the soda salt of alizarin and the sodic sulphite. The alizarin salt so formed remains in solution, giving to the liquid a beautiful violet colour. From this solution sulphuric acid precipitates the alizarin as an orange-yellow substance. It is allowed to settle in large tanks, and then is run, in the form of a yellowish mud, which contains either 10 or 15 per cent of dry alizarin, into barrels, and is in this form sent to the print-works, and used much in the same way as the original ground madder was used.

The alizarin mud, as I have called it, containing but 10 per cent of dry alizarin, is equal in dyeing-power to about 8 times its weight of the best madder, and is the pure substance required for the dyeing, in place of a complicated mixture containing certain constituents which have a positively injurious effect on the colours produced.

The scientific knowledge and energy which Mr. Perkin has brought to bear on the manufacture of this colouring matter seem already to have worked wonders. The demand and supply of artificial alizarin are increasing at a most rapid rate, and yet the manufacture of it seems hardly to have commenced. The value of madder has much decreased; and in fact, judging by what occurred in the year of revolution and commercial depression (1848), when the price of madder fell for a time to a point at which it was considered it would no longer remunerate the growers to produce it, that point has now been again reached, but certainly from very different reasons. Last year* artificial alizarin equal in value to about one-fourth of the madder imported into England was manufactured in this country. This year the amount will be much larger.

Thus is growing up a great industry, which, far and wide, must exercise most important effects. Old and cumbrous processes must give way to better, cheaper, newer ones; and, lastly, thousands of acres of land in many different parts of the world will be relieved from the necessity of growing madder, and be ready to receive some new crop. In this sense may the theoretical chemist be said even to have increased the boundaries of the globe.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.†

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 141.)

Lecture IV.

The Energy of Affinity, especially with reference to Considerations for the Measurement and Utilisation of it.

The energy of affinity assumes many Protean forms, embracing facts in very opposite phases. At one time it seems to hold elemental matter in adamantine chains so firmly that no appliances, such as heat or light or electricity, can undo the bonds; at another time there seems to be a repellent power of affinity (contradictory though the expression may sound) so influencing, that though every facility for voluntary combination be presented, yet none of these inducements accomplish this combination. For example, the oxygen and nitrogen in the atmosphere, which for all general purposes may be said never to enter combination whilst acting as atmosphere. Again, oil and water—neither shaking nor heating can cause mixture, let alone combination. This repellent power is utilised in vitality thus:—The fluid which lubricates the eyeball would continually pass over the edges of the lids, and so run down the cheeks, were there not glands upon the edge of the lids that secrete a very little oil, and so by

* On the 1st of this month (September) the value of madder-roots in France was 24 to 26 francs per 50 kilogrammes. The average price in 1873 was 27, but in June and July of that year it was 22 francs.

† The Cantor Lectures, delivered before the Society of Arts.

virtue of this "repellent affinity" the ordinary fluid is confined to its appointed channel. If this fluid be excessive, the oily boundary is overflown, and tears trickle down the cheeks.

On reference to the diagram on the wall, it is stated that the energy of affinity is manifested in mechanical action, and it is probably the source of the mechanical power utilised by men for manufacturing purposes. We find affinity operating under all circumstances in which the character of a resulting compound is different from that of the elementary bodies which constitute the compound. Affinity may be said to be kinetic when converted, and potential when in molecular relation. In other words, all the molecules of one body are somehow or other related by affinity to the molecules of another body, either directly or indirectly, when states of change are occurring. Under these circumstances, until the new molecular relations are called forth, there is potential energy: as these are brought about we get kinetic energy.

The term "Affinity," as employed in this course of lectures, needs an explanation. As a term in science it is fairly derived from that sense in which it ought to be used in conversation or ordinary writing. The word, when properly applied, is in reference to those connections which a marriage may have established between the relatives of the wedded pair. Prior to that marriage there were no relationships; after it, relationships enter by *affinity*. The relatives of the husband are connected to him by consanguinity, so are the relatives of the wife to her, but after the marriage these two sets of relatives are connected each to the other by affinity. This distinction makes clear that affinities are regarded only as between different bodies. No affinity can exist between lead and lead, or between oxygen and oxygen. As in social life, the legal relationships resulting from affinity and consanguinity are very different, so in science life the atoms which constitute the elementary parts of a simple body, and the molecules which constitute the elementary parts of a compound body, are tied together in bonds of different kinds.

Between atom and atom, or molecule and molecule of a like nature, there are no affinities. True, these are held together, but it is by what is sometimes called the force of cohesion. If atom or molecule of one nature is, thus unchanged, held to an atom or molecule of another nature, then the bond is one of adhesion. If, for example, these two plates of smooth glass be slid one over the other and pressed together they cohere. If gum be dropped on one and the other pressed upon it, they then adhere. Water adheres to many substances of very different constitution.

To cohesion we are indebted for the strength of solids. The cohesive force operates, but in marvellously different degrees, in ice, water, and steam. To adhesion we are indebted for those unions effected by cements, &c. With the intensity of these two subsidiary agents in the work of affinity this lecture is not concerned, although they perform no unimportant parts.

Between affinity, if used as a term in physics, and if used as a term in chemistry, there is this distinction:—Students in physics might classify cohesion and adhesion as branches of affinity. Students in chemistry would not admit the term (affinity) unless the composing elements after the influence of affinity have undergone such a change as to obliterate all traces of the originals. Hence the phrase "chemical" affinity, thus, by the prefix "chemical," excluding the physicist's views.

An experimental illustration may make clear the use of the term "affinity" by the respective students in physics and chemistry.

Here are two solutions, the one of gum dissolved in water, the other of camphor dissolved in spirits of wine. These two are respectively mixed, nevertheless there is in neither case any chemical affinity. If we add pure spirits of wine to the mixture of gum and water, we should destroy what the physicist might call the affinity, but which the chemist does not admit to be such. On the other hand, if we add water to the solution of camphor we destroy the mixture there; a separation takes place, and in one case the gum, and in the other the camphor, is precipitated. The term "affinity," applied to the unions thus separated, would not to a physicist seem improper; the chemist would not permit the use of this word. It is in the chemist's sense that the word is used in the phrase "energy of affinity." He distinguishes thus:—the term "combination" is applied by him to the results of affinity, and to that which has just been described as a phenomenon in physics the chemist applies the term "mixture."

These preliminary distinctions prepare us for an explanation of what we are to understand by those affinities whose energies are to be considered. Used in a chemical sense, affinity is that power which influences bodies dissimilar in composition, form, and character to combine. The consequence of this union is the formation of new compounds, which may or may not be dissimilar in colour, form, and every fashion, to any of the composing bodies, which may or may not be possessed of properties and characters that are not even traceable in the originals. These compound bodies, thus unlike their progenitors, also establish relationships of affinity, and we are soon surrounded with numerous compounds, so diverse that all traces of the originals are to ordinary apprehensions totally obliterated.

There is, however, amongst these bodies a kind of clanship or caste, similar to that amongst the people of India. Thus, simple or elementary bodies combine only with simple or elementary ones; compound bodies only with compound ones.

For example—Oxygen, which is a simple body, enters into the alliance of affinity with the metals, which are also simple bodies.

Here is some pure metal—lead—in a state of very minute subdivision. It is enclosed in an air-tight glass tube. This lump of lead is exactly the same material. The difference is, that in the finely subdivided metal in the glass tube combination with oxygen will take place the moment it is exposed to the air, so that the atoms of lead which are soon to be shaken out are brought into contact with the oxygen—atom with atom.

Thus, on breaking off the end of the glass tube and shaking out the contents, you see the black particles, as they fall, glow with heat, owing to their rapid combination with the oxygen of the atmosphere. Here is a case of affinity, consequent on a state of subdivision—a case of affinity proper. Mr. Wills, who most kindly this evening gives us the benefit of his chemical knowledge and experimental skill, will now show you how strong is the affinity of oxygen for the steel blade of a knife; when heated and placed in a stream of oxygen the ignited particles of steel in the blade rapidly burn away. The same thing happens if a stream of oxygen is directed on any of the simple metals when raised to a red heat. In a hollow on this tile are some iron nails; by directing a stream of ignited hydrogen in oxygen upon them, the affinity is so strong that they not only melt but boil, and the ebullition is so powerful that a brilliant shower of molten metal is scattered around. Similarly, a piece of zinc when exposed to oxygen is rapidly consumed.

But when we deal with acids which are compounds, they do not ally themselves by affinity with the simple metals, but only with the oxides of the metals, which, like themselves, are compound bodies.

The range of the energies of affinities is very great. For example, oxygen and the metals. Oxygen can with difficulty be induced to unite with gold and platinum—hence these metals do not tarnish in the air; with sodium and potassium the affinities are so strong that the union is rapid enough to generate both light and heat. Either to facilitate or prevent such union, and so promote or retard the energy of affinity, has led to the adoption of various compounds, under the name of fluxes.

It may be well to explain that to this energy of affinity we may be said to owe the variety which the earth possesses. Reduce its compounds into their elements, and a sample of each of all of which the world is made might be arranged on this table. There are now only 63 reputed elements: from the affinities amongst these 63, whether taken by twos, or threes, or fours, or more, everything is made. Indeed, $\frac{99}{100}$ths of the earth is made of 13 elements; the mathematician's calculation is an easy one which could tell the number of articles that might be formed by combining these 13 by twos, then by threes, then by fours, and so on to 13. There would thus, out of these elements, be 8191 different compounds. This number is very naturally increased from the operation of what may be called the law of combination in multiple and sub-multiple proportions. Allowing another 8191 for these multiples and sub-multiples, there would be in the world composed of these 13 elements 16,382 articles. Such a calculation as this is exceedingly simple, and the mathematician would say must be correct. Affinity, however, enters with a "veto." It claims the right to determine the nature of any combination or set of combinations, and in the exercise of this claim the character and constitution of the combining elements are so completely altered as to have lost all obvious trace of their original, and, therefore, when the combination by threes takes place the result does not partake of the character of any one of the components. This change of character is what the mathematician's calculation does not reckon upon; indeed such a calculation is based upon the physicist's interpretation of the word affinity, and it ignores the chemist's views.

The problem which is now before us is to define a mode of measuring the transformations in every shape introduced by affinity amonst these thirteen elements; a problem very simple, as thus stated, but wondrously complicated,—in fact only capable of an approximate or inferential solution, which is, practically, no solution at all.

In a homely way this difficulty may be illustrated within the walls of many a house. Assume the residents to be a father and mother and thirteen children. Who can tell the combinations consequent upon what may be called the mutual affinities existing amongst these thirteen children? Even from day to day the stability of that family cannot be ensured. The combinations of twos and threes, which yesterday gave promise of permanency, is to-day dissolved, and these molecular children form other alliances. This microcosm of a world is under the influence of new feelings, changed tastes; indeed it passes, with more than electrical rapidity, from a summer-like happiness to a wintry gloom—from a peaceful calm to lurid flashes—sad forebodings of domestic storms!

Well, amongst the affinities of the thirteen terrestrial elements similar changes and relations are induced. Whilst we may be able to tell with unerring exactitude how any *two* may act, if left to settle themselves under the sole influence of their dual affinities, when three or four, or more, come together, certain perplexity results.

(To be continued).

NOTICES OF BOOKS.

Scientific Handicraft; a Descriptive, Illustrated, and Priced Catalogue of Apparatus, suitable for the Performance of Elementary Experiments in Physics. By J. J. Griffin, F.C.S. Vol. I.: Mechanics, Hydrostatics, Hydrodynamics, and Pneumatics. London: J. J. Griffin and Sons.

Most of our readers are familiar with Griffin's "Chemical Handicraft," a work which is at once a trade catalogue and, to some extent, a treatise on chemical manipulation. The book before us is an extension of the same idea to other departments of experimental science. It must, however, be noted that the mere trade department is much less prominent than in "Chemical Handicraft," whilst the amount of information on the use of the various pieces of apparatus and the principles they illustrate is much enlarged. We have no doubt that the work will be found very valuable both to teachers and students in enabling them to select without loss of time the precise articles they may require. In looking over the descriptions and figures of specific gravity bottles, pipettes, burettes, &c., we cannot help expressing a wish that the "septem" may at an early date disappear both from graduated apparatus in the laboratory and from the pages of scientific manuals. We ask further,—is it beyond the power of scientific men to agree upon some one standard graduation for hydrometers, both for liquids lighter and for those heavier than water? If the Continent has the advantage over England in the simplicity of its weights and measures, it falls behind us in another respect, owing to the number and complexity of its hydrometric scales.

We presume that the volume before us is the first of a series which will doubtless embrace all the other departments of physical science.

Lectures on Practical Pharmacy. By Barnard I. Proctor. London: J. and A. Churchill.

The increasing demand for scientific instruction, about which we hear so much, is not always of that tangible nature which leads to permanent results. Those who come forward to meet it often find it vanish away. Of this our author gives a somewhat pathetic instance in his "prefatory letter." About a dozen years ago, in consequence of a local movement, he accepted a lectureship on pharmacy at the Newcastle Pharmaceutical School. "The attendance, at first satisfactory, gradually diminished till, during the third year of the school's existence, I had the honour of reading a paper on Sulphur, and performing the experiments in illustration, before an audience of *one*." Who that has ever accepted the honorary chair in any branch of physical science at a Mechanics' Institute, or any similar body, has not to tell of some analogous experience? Such results wound our vanity, indeed; but they do something more. They convince us that a long time must elapse, or a radical change ensue, before we can hope to overtake our competitors on the other side of the North Sea.

From this abortive pharmaceutical school, and from the pharmacy lectureship subsequently appended to the Newcastle Medical College and held by the author, has sprung the present work. Mr. Barnard modestly proclaims himself as still a student rather than a teacher, and apologises for the want of uniformity in thermometrical scales, weights, and measures, equivalent numbers and nomenclatures made use of. Nomenclatures have, indeed, become so numerous and complicated, that a dictionary of chemical synonyms would be of no trifling utility to all who have to make themselves acquainted with chemical literature.

The work before us contains sections on the principal chemical operations practised in pharmacy; on the various classes of officinal preparations; on dispensing and reading prescriptions, illustrated with lithographed fac-similes of medical kakography; on qualitative and quantitative testing, and on the pharmacy of special drugs. Each section concludes with a brief summary or recapitulation, and questions for self-examination. The various processes are carefully and clearly described, with indication of niceties important to success, but which the student might otherwise overlook. We might instance the lectures on precipitation, crystallisation, diffusion, and dialysis, as happy specimens of the golden mean between the diffuseness that encumbers and the brevity that perplexes. The author contrives, in passing, to point out not a few prevalent errors both in standard works and in vague professional opinion, whilst the only flaw which we have detected is the statement,—probably a typographical error,—that the *sulphate* of antimony treated with strong

hydrochloric acid evolves sulphuretted hydrogen. The illustrations are numerous and appropriate, but a more complete index would have been beneficial. Altogether we must pronounce the work a good specimen of a treatise on chemistry as applied to a special art, and as such we can recommend it to pharmaceutical students and to pharmacists in general.

CORRESPONDENCE.

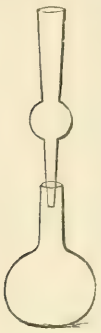
PREPARATION OF NORMAL ACID.

To the Editor of the Chemical News.

Sir,—I find the following a very easy and accurate method of making a standard acid, and as I have not seen it in any of the books on analysis, perhaps it may be of some use:—

Dilute commercial HCl with ten times its volume of water, pass an excess of SH_2 through the mixture and boil for a few minutes, allow to settle, then filter or decant off the precipitate. It is next to be distilled until 9-10ths of the acid has passed over, and the distillate diluted to about 1020 sp. gr.

A piece of Iceland spar (about 8 or 10 grms.) is to be accurately weighed and placed in a flask together with 100 c.c. of the acid as prepared above. A chloride of calcium tube, filled with pieces of glass, is to be fitted to the flask, as in figure. A few drops of solution of litmus (which must be just blue) is to be poured through the $CaCl_2$ tube into the flask. The contents of the flask must be kept boiling gently until the litmus in it turns blue, then the remains of the crystal is to be taken out, washed, dried, and re-weighed. The loss in weight of the crystal indicating the strength of the acid, the latter can now be standardised. Thus, as 5 is to the loss of weight in grammes of the crystal, so is 100 c.c. to the number of c.c. of the acid, which must be taken and made up to 100 c.c. As the litmus in the $CaCl_2$ tube remains blue, we know that there has been no loss of acid.—I am, &c.,



George Duerr.

The Laboratory, Heywood,
September 9, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, August 18, 1873. (Continued).

Secondary Currents and their Applications.—Extract from mémoir by M. Planté.—In studying the phenomena of his secondary couples (formed with plates of lead) the author found that the chemical change in the electrodes, which forms the source of the secondary current, is rendered more complete by a primary current being passed alternately in opposite directions, and repose allowed between each double action. By the former, the deposits of oxide are reduced, then recomposed, and the electrodes are thus modified in molecular constitution, not only at the surface, but by degrees interiorly, giving an increasing effect for years. By the latter (repose) the deposits of oxidised or reduced metal acquire a crystalline texture and a strong adherence, which contributes to protect the subjacent deposits tending to form under the action of the primary current. These operations M. Planté designates the *formation* of secondary couples. A secondary couple with less than half a metre of surface properly formed will, when charged with two Bunsen elements, redden a platinum wire half a m.m. diameter during twenty minutes, or a wire $\frac{2}{10}$ m.m. diameter for an hour, without any communication with the primary source, and even forty-eight hours after being charged. After formation has once been effected the secondary couple may be charged by a current acting always in the same direction. M. Planté exhibited an apparatus so arranged that, by touching a metallic point in a box containing a secondary couple, a platinum wire was heated, and might be used to light a candle, a spirit-lamp, or gas. The primary pile consisted of 3 elements of zinc and water, copper and sulphate of copper. The secondary couple once charged may give a hundred consecutive lightings. With an apparatus somewhat larger one may obtain 3000 to 4000. This mode obviates many disadvantages connected with the use of matches; and it is very economical. For there is no expense connected with the secondary couple; the lead and liquid do not need renewal. And to maintain the weak current of the primary pile necessary to charge the secondary couple one has only to add some crystals of sulphate of copper; the consumption of which is very small compared with the large number of lightings obtainable. M. Planté proposes also to employ his secondary couples for electric bells, and describes how this may be done.

Variations of Urea under the Influence of Caffein, Coffee, and Tea.—M. Rabuteau.—The author cites his experiments made in 1870 in opposition to those recently made by M. Roux, who considers tea and coffee do not prevent denutrition of tissues.

Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften, Vienna, October, 1872.

On Nicotin.—Dr. H. Weidel.—The author chiefly examined combinations of nicotic acid, which was obtained by oxidation of nicotin with nitric acid, and to which he gives the formula $C_{10}H_8N_2O$. The compounds studied were those with nitric acid, hydrochloric acid, bromide of hydrogen, sulphuric acid, hydrochlorate of double salt of platinum, two with silver, and lime. The platinum salt and the lime combinations gave beautiful crystals of the oblique prismatic system. Dr. Weidel further compared with nicotic acid another acid obtained from nicotin by Huber, by oxidation with chromic acid, viz. ($C_6H_5NO_2$).

On Excretin.—F. Hinterberger.—Marcet regarded excretin as a sulphur-containing substance, with formula $C_{78}H_{156}SO_2$. Hinterberger has succeeded in getting it free from sulphur, and gives as its simplest formula $C_{20}H_{36}O$; which shows a close correspondence to cholesterin, $C_{26}H_{44}O$. But cholesterin is less easily dissolved in vinegar than excretin, and the solution shows in the microscope beautiful sericeous six-sided prisms, while the excretin solution forms round masses. Treated with bromine excretin gave a crystallising compound with formula $C_{20}H_{34}Br_2O$; but the author did not succeed in preparing chloride of excretin.

Behaviour of Non-Conducting Substances under the Influence of Electrical Forces.—M. L. Boltzmann.—The author deduced from Helmholtz's theory of dielectricity that electric forces may exercise considerable attraction on a non-conductor simply through dielectric polarisation; that a non-conducting ball in a homogeneous electric field should be $\frac{D-1}{D+2}$ times as strongly attracted as a similar and insulated conducting ball acted on by the

same force through induction; D being the constant of dielectricity. In a first series of experiments values of D were obtained with a condenser, a battery, and an electrometer for hard gum, sulphur, paraffin, and colophony. In a second series the method of experiment was briefly as follows:—A ball of the insulating substances was hung by a silk thread at the arm of a delicate balance whose motions were indicated by a small mirror. Near this movable ball was a fixed one which could be charged from a machine with either positive or negative electricity. For the non-conducting ball an equal sized conducting one could be substituted. A second balance with conducting ball suspended near the fixed ball served as measure of the quantity of electricity. Comparison was now made between the attractions of the non-conducting and the conducting balls on the first balance to the fixed ball. The numbers given in a table show how much more the conducting ball was attracted than the non-conducting one. According to the theory of dielectrics these numbers should have the value $\frac{D+1}{D-2}$ The values of D deduced from this are compared with those from the former measurement. In some cases there is pretty close agreement; in others difference. It was observed that the longer the electric action the more considerable was the dielectric polarisation. M. Boltzmann thinks his method should yield valuable results on the hitherto little studied behaviour of insulators in the electric field. The author further views his numbers in connection with Maxwell's hypothesis that light and electricity are different forms of motion in one and the same medium. Between the dielectric constant, D, and the refractive index, i, of any substance, Maxwell obtained the relation $i = \sqrt{D\mu}$, where μ is the coefficient of magnetic induction. This coefficient in the four above mentioned substances cannot be very different from air, which is taken as $=1$. So that we have the index of refraction equal to the square root of the constant of dielectricity. M. Boltzmann accordingly compares the square roots of these constants as found by his method with the refractive indices as determined by Wollaston's method; and the differences are not sufficiently great not to be attributed to unavoidable errors of observation. He considers these results, though not so accurate as to lead to the identification of light and electricity, yet furnish strong support to Maxwell's theory.

Stroboscopic Determination of the Pitch of Tones.—M. Mach.—In the apparatus used by the author there is a cylinder which makes three revolutions in a second, and is divided into five octaves. At one end of it begins 10 bands, which, however, become more numerous and dense towards the other end, being there 320. To the axis of a syren is fixed a disc having equidistant radial slits of the same number as the holes in the syren-disc. The surface of the rotating cylinder is looked at through this slitted disc, while the syren tone is gradually raised. According to the stroboscopic principle the bands look distinct and at rest where there pass before the eye an equal number of them and of slits in the disc. If a scale of numbers of vibration be attached to the cylinder, the number of vibrations of the syren can be at once ascertained by observing the part corresponding to the distinct and still ring of the cylinder. One sees, however, distinct and at rest, not only the part of the cylinder corresponding to the number of vibrations of the syren, but also all those parts which correspond to the harmonic over tones. Of all such parts it is, of course, that one which furnishes the smallest number of vibrations that corresponds to the vibration-number of the syren. (The author gives further details of the apparatus.) The determination may be varied in accuracy by varying the bands on the paper of the rotating cylinder. The apparatus may be applied to other sounding bodies. Thus let a mono-chord string be stretched at right angles to the axis of the cylinder; then simple teeth (Zachen) appear where the sounding string is opposite that part of the cylinder indicating the same number of vibrations. Another application is to attach small mirrors to tuning-forks, and watch in them the image of the rotating cylinder. An organ pipe may be also submitted to observation with aid of König's capsules and dancing jets.

Heat Equilibrium among Gas Molecules.—Boltzmann.—A lengthy mathematico-physical paper, treating the subject under the six heads of—(1) Consideration of one-atomed gas molecules; (2) replacement of integrals with sums; (3) diffusion, friction, and conduction of heat in gases; (4) consideration of several-atomed molecules; (5) the molecules do not make many vibrations between one collision and the next; (6) solution of equation and calculation of eutrophy.

Moniteur Scientifique, du Dr. Quesneville, September 1873.

Theory of Tanning.—A. Reimer.—A continuation of the important treatise translated from *Dingler's Polytechnisches Journal*, 1872.

On Anthrapurpurin.—W. H. Perkin.—A translation from the *Transactions* of the London Chemical Society.

On Anilin Black.—Ch. Lauth.—Abstracts of this paper and of the two following have already appeared in the Chemical News.

Wool Dyeing with Anilin Green.—Ch. Lauth.

Action of Hydrochloric Acid Gas on the Compound Ammonias.—Ch. Lauth.

Process for Determining the Anilin Colours by Means of the Hydrosulphite of Soda.—A. Stamm.—This process has been already given in the Chemical News.

Chemical Guide to the Vienna Exhibition.—A. Bauer and J. Stingl.—A translation from the *Transactions* of the Berlin Chemical Society.

Determination of Paraffin in Candles sold as Stearin.—E. Donath.—M. Hock had proposed to saponify the sample to be examined with a soda lye, and to salt out the soap formed by an addition of common salt. This precipitate carries down with it the paraffin, which of course has not been saponified by the alkali. The whole is collected on a filter, washed with water, or with very dilute alcohol, which dissolves out the soap, and dried at 35° to 40°. The paraffin is then dissolved in ether, and the solution evaporated to dryness. The weight of the residue shows the amount of paraffin. Donath having tried this method finds that it is very difficult to remove the soap from the filter in the cold by washing with water or dilute alcohol, whilst if the solvent be applied hot, or even slightly warmed, the paraffin forms an emulsion and runs through the filter. The solution of paraffin in ether is also a slow process. Hence Donath proposes the following modification:—6 grms. of the sample are boiled for half-an-hour with 200 to 300 c.c. of potash-lye, specific gravity, 1·15, and chloride of calcium is then added so as to produce a complete precipitation. If a large admixture of paraffin is suspected a quantity of carbonate of soda is added to the chloride of calcium, which gives rise to the formation of carbonate of lime, and renders the precipitate more easy to pulverise. The lime-soap with which the paraffin is mechanically entangled is washed on the filter with hot water and dried at 100°. The mass is then pulverised and exhausted in a displacement apparatus with cerosolin (essence of petroleum). The solution obtained is evaporated, and the residue after being dried at 100° is weighed as paraffin. On operating upon known mixtures the author has obtained results correct to 0·3 per cent.

Determinations of Acids in Oils.—M. Burstynn.—To 100 c.c. of the oil in question the author adds an equal volume of alcohol at 90 per cent and shakes stongly. The whole is then left to settle for some hours, when two layers are formed. The one is oil perfectly free from acid,

the other consists of alcohol containing the fatty acids and a trace of oil. Of this latter portion 20 c.c. are taken and titrated with a standard solution of soda. If several free fatty acids are present, the caculation is made for one only, employing the equivalent of the one present in the largest proportion. The results obtained are sufficiently accurate for practical purposes.

Adulteration of Wax with Tallow.—M. Hardy.—Wax floats upon alcohol at 29°. By determining the strength which alcohol must have so that the sample may float upon its surface, the quantity of wax may be found in a sample falsified with tallow only:—

When the Alcoholometer marks—	The Wax contains—
29·00°	100 per cent
39·63°	75 ,,
50·25°	50 ,,
60·87°	25 ,,
71·50°	0 ,,

Determination of Manganese in Cast-Irons and Steels.—F. Kiesser.—One of the main causes of the loss of manganese in these determinations springs from the employment of too large an amount of acetate of soda in the previous precipitation of the iron. The author finds that in a perfectly neutral solution 1 grm. acetate of soda suffices to precipitate completely 1·1 grm. of iron in 500 c.c. of solution, and even in presence of 1 grm. of acetic acid. When the determination of the manganese alone is required, he cools the liquid, makes up its volume to 500 c.c., filters through a dry filter, and determines the manganese in 250 c.c.

Definition of Explosive Force.—M. R. Radau.—A mathematical paper on the measurement of the force of explosive bodies.

Means of Comparing Samples of Gunpowder.—M. de Tromenic.—The apparatus proposed is a cylindrical vessel of cast steel of the capacity of half a litre. The sides are 3 to 4 centimetres in thickness. The cylinder is closed with a screw stopper pierced by a central channel provided with a tap and two lateral orifices, into which are cemented two wires from an electric apparatus to ignite the charge. It would be useful to fix a thermo-electric element in one of the sides of the cylinder to indicate the temperature of the gases in periods following the explosion. The cylinder is placed in a sheet-iron receiver full of water which serves as a calorimeter, and which is again enclosed in a trough full of cotton to avoid loss of heat. The cylinder is fixed immovably by a pressure-screw resting upon the stopper. A thermometer measures the temperature to about $\frac{1}{100}$th of a degree. The water is provided with an agitator.

Heat of the Combustion of Explosive Bodies.—MM. Roux and Sarrau.—A mathematical paper.

Pyrometer for the Determination of High Temperatures.—J. Salleron.—The description of this instrument would be unintelligible without the accompanying diagrams.

Revue Universelle des Mines, de la Metallurgie, des Travaux Publics, des Sciences et des Arts Appliqués a l'Industrie, May and June, 1873.

Chemical Industry at the Vienna Exhibition.—This paper is a translation from the German Catalogue of the Exhibition, and is mainly due to Prof. A. W. Hofmann, of Berlin. The subjects principally treated of are the recent improvements in the manufactures of sulphuric acid, of soda, of chlorine, of potash, of paraffin, and of colouring matters. We extract the following interesting facts concerning the Stassfurt and Leopolds Hall potash works:—The chloride of potassium obtained, ranging in strength from 98 to 80 per cent, serves for the preparation of saltpetre, sulphate of potash, potash, and alum. The annual yield is about a million centners. The potassic manurial salts are mixtures of the chloride of potassium, with different proportions of sulphate of magnesia and common salt. The annual yield is a million and a quarter centners. The production of potash and sulphate of potash amounts to fifty thousand. Sulphate of magnesia, crude and crystallised (Kieserite and Epsom salts), is obtained to the extent of a quarter of a million centners. Chloride of magnesium, crystallised and fused, 130,000 centners. Sulphate of soda, crystallised and calcined, is obtained from sulphate of magnesia and chloride of sodium by double decomposition at low temperatures, to the extent of 150,000 centners. About 400 centners of boracic acid, and 700 of bromine are also produced yearly. Since the opening of the Stassfurt mines the price of chloride of potassium has fallen from 21s. to 24s. per centner to from 7s. to 9s. Bromine up to 1865 cost 48s. to 51s. per kilo; its price is now from 9s. to 10s. 6d. The deposits of Kalnez, in Gallicia, have only been worked since 1869. There are found there rich and heavy beds of sylvine and kainite; below which carnallite will probably be discovered. The section on colouring matters will give the reader cause for reflection. That England should be obliged to import 8000 cwts. of artificial alizarin yearly whilst she exports the raw material, anthracen, is simply a national disgrace. That Germany alone produces about one-half of the anilin colours consumed in the world is a fact that clashes strangely with our notions of manufacturing supremacy.

Condition of Mining in the Island of Sardinia.—M. Sella.—(Continuation.)—Ores of iron, copper, manganese, and antimony, and the lignites of the tertiary basin of Gonnesa have been worked at different times, but without success. Iron ores are tolerably abundant, especially the magnetic protoxide, which is found in veins and masses in the granite and the superjacent Silurian schists. Hæmatite is found in the trachytic formation. The principal copper ore is chalcopyrite, found in the argillaceous schists of the Silurian regions. Some fine specimens of sulphide of antimony have been found at Su Suergin, in the centre of the island, accompanied by an argillaceous gangue. Pyrolusite is found to a considerable extent at Capo Rosso, on the western coast, but of low quality. At Fluminimaggiore occurs an ore of nickel and cobalt, yielding 20 per cent of the two metals. The difficulty of transport, and the distance from a market, render many of the Sardinian mineral deposits practically worthless.

MISCELLANEOUS.

The American Association for the Advancement of Science.—This Association held its twenty-second annual meeting at Portland, Maine, beginning Wednesday, August 20th. The Officers of the meeting are as follows:—President, Prof. Joseph Lovering, of Cambridge, Mass.; Vice-President, A. H. Worthen; Permanent Secretary, F. W. Putnam; General Secretary, C. A. White. The attendance of members was large, and a goodly number of papers were presented. Strictly chemical papers, however, were few, the deficiency being even more marked than usual. The titles of the papers on chemical and closely related subjects are as follows:—"On the Silt Analysis of Soils and Clays," E. W. Hilgard; "Analysis of Mississippi Soils and Subsoils," E. W. Hilgard; "On the Distribution of Soil Ingredients in the Sediments obtained by Silt Analysis," R. H. Loughbridge; "On the Influence of Strength of Acid, and Time of Action on the Results of Chemical Soil Analysis," R. H. Loughbridge; "Remarks on Plate Lime-Glass and the Manufacture of Glass in General," L. Feuchtwanger; "The Chemistry of Copper Matte," T. Sterry Hunt; "Metaphysical Theory of Chemistry *versus* the Atomic," Clinton Roosevelt. As in former years subjects connected with geology and natural history formed the bulk of the papers.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Bradford Meeting, September 17, 1873.

INAUGURAL ADDRESS OF THE PRESIDENT,

Alexander W. Williamson, Ph.D., F.R.S., F.C.S.

(Concluded from p. 148).

I trust that the facts which I have submitted to your consideration may suffice to show you how fallacious is that materialistic idea of Physical Science which represents it as leading away from the study of man's noblest faculties, and from a sympathy with his most elevated aspirations, towards mere inanimate matter. The material work of science is directed by ideas towards the attainment of further ideas. Each step in science is an addition to our ideas, or an improvement of them. A science is but a body of ideas respecting the order of nature.

Each idea which forms part of Physical Science has been derived from observation of nature, and has been tested again and again in the most various ways by reference to nature; but this very soundness of our materials enables us to raise upon the rock of truth a loftier structure of ideas than could be erected on any other foundation by the aid of uncertain materials.

The study of science is the study of man's most accurate and perfect intellectual labours; and he who would know the powers of the human mind must go to science for his materials.

Like other powers of the mind, the imagination is powerfully exercised, and at the same time disciplined, by scientific work. Every investigator has frequent occasion to call forth in his mind a distinct image of something in nature which could produce the appearances which he witnesses, or to frame a proposition embodying some observed relation; and in each case the image or the proposition is required to be true to the materials from which it is formed. There is, perhaps, no more perfect elementary illustration of the accurate and useful employment of the imagination than the process of forming in the language of symbols, from concrete data, one of those admirable general propositions called equations; on the other hand, the contemplation of the order and harmony of nature as disclosed to us by science supplies the imagination with materials of surpassing grandeur and brilliancy, while at the same time affording the widest scope for its efforts.

The foregoing considerations respecting the meaning and use of scientific work will, I trust, afford us aid in considering what measures ought to be taken in order to promote its advancement, and what we can do to further the adoption of such measures.

Like any other natural phenomenon, the growth of knowledge in the human mind is favoured and promoted by certain circumstances, impeded or arrested by others; and it is for us to ascertain from experience what those circumstances respectively are, and how the favourable ones can be best combined to the exclusion of the others.

The best and noblest things in this world are the result of gradual growth, by the free action of natural forces; and the proper function of legislation is to systematise the conditions most favourable to the free action which is desired.

I shall consider the words "Advancement of Science" as referring to the development and extension of our systematic knowledge of natural phenomena by investigation and research.

The first thing wanted for the work of advancing science is a supply of well-qualified workers. The second thing is to place and keep them under the conditions most favourable to their efficient activity. The most suitable men must be found while still young, and trained to the work. Now I know only one really effectual way of finding the youths who are best endowed by nature for the purpose; and that is to systematise and develop the natural conditions which accidentally concur in particular cases, and enable youths to rise from the crowd.

The first of these is that a young man gets a desire for knowledge by seeing the value and beauty of some which he has acquired. When he has got this desire, he exerts himself to increase his store; and every difficulty surmounted increases his love of the pursuit, and strengthens his determination to go on. His exertions are seen by some more experienced man, who helps him to place himself under circumstances favourable to further progress. He then has opportunities of seeing original inquiries conducted, perhaps even of aiding in them; and he longs to prove that he also can work out new truths, and make some permanent addition to human knowledge. If his circumstances enable him to prosecute such work, and he succeeds in making some new observations worthy of publication, he is at once known by them to the community of scientific men, and employed among them.

We want, then, a system which shall give to the young favourable opportunities of acquiring a clear and, as far as it goes, a thorough knowledge of some few truths of nature such as they can understand and enjoy—which shall afford opportunity of further and further instruction to those who have best profited by that which has been given to them, and are anxious to obtain more—which shall enable the best students to see what original investigation is, and, if possible, to assist in carrying out some research—and, finally, which shall supply to each student who has the power and the will to conduct researches, all material conditions which are requisite for the purpose.

But investigators, once found, ought to be placed in the circumstances most favourable to their efficient activity.

The first and most fundamental condition for this is, that their desire for the acquisition of knowledge be kept alive and fostered. They must not merely retain the hold which they have acquired on the general body of their science; they ought to strengthen and extend that hold, by acquiring a more complete and accurate knowledge of its doctrines and methods; in a word, they ought to be more thorough students than during their state of preliminary training.

They must be able to live by their work, without diverting any of their energies to other pursuits; and they must feel security against want, in the event of illness or in their old age.

They must be supplied with intelligent and trained assistants to aid in the conduct of their researches, and whatever buildings, apparatus, and materials may be required for conducting those researches effectively.

The desired system must therefore provide arrangements favourable to the maintenance and development of the true student spirit in investigators, while providing them with permanent means of subsistence, sufficient to enable them to feel secure and tranquil in working at science alone, yet not sufficient to neutralise their motives for exertion; and at the same time it must give them all external aids, in proportion to their wants and powers of making good use of them.

Now I propose to describe the outlines of such a system, framed for the sole purpose of promoting research, and then to consider what other results would follow from its working.

If it should appear possible to establish a system for the

efficient advancement of science, which would be productive of direct good to the community in other important ways, I think you will agree with me that we ought to do all that we can to promote its adoption.

Let the most intelligent and studious children from every primary school be sent, free of expense, to the most accessible secondary school for one year; let the best of these be selected and allowed to continue for a second year, and so on, until the *élite* of them have learnt all that is to be there learnt to advantage. Let the best pupils from the secondary schools be sent to a college of their own selection, and there subjected to a similar process of annual weeding; and, finally, let those who get satisfactorily to the end of a college curriculum be supplied with an allowance sufficient for their maintenance for a year, on condition of their devoting their undivided energies to research, under the inspection of competent college authorities, while allowed such aids and facilities as the college can supply, with the addition of money-grants for special purposes. Let all who do well during this first year be allowed similar advantages for a second, and even a third year.

Each young investigator thus trained must exert himself to obtain some appointment, which may enable him to do the most useful and creditable work of which he is capable, while combining the conditions most favourable to his own improvement.

Let there be in every college as many Professorships and Assistantships in each branch of science as are needed for the efficient conduct of the work there going on, and let every Professor and Assistant have such salary and such funds for apparatus, &c., as may enable him to devote all his powers to the duties of his post, under conditions favourable to the success of those duties; but let each Professor receive also a proportion of the fees paid by his pupils, so that it may be his direct interest to do his work with the utmost attainable efficiency, and attract more pupils.

Let every college and school be governed by an independent body of men, striving to increase its usefulness and reputation, by sympathy with the labours of the working staff, by material aid to them when needed, and by getting the very best man they can, from their own or any other college, to supply each vacancy as it arises.

In addition to colleges, which are and always have been the chief institutions for the advancement of learning, establishments for the observation of special phenomena are frequently needed, and will doubtless be found desirable in aid of a general system for the advancement of science.

Now, if a system fulfilling the conditions which I have thus briefly sketched out were once properly established on a sufficient scale, it ought to develop and improve itself by the very process of its working; and it behoves us, in judging of the system, to consider how such development and improvement would come about.

The thing most needed at the present time for the advancement of science is a supply of teachers devoted to that object—men so earnestly striving for more knowledge and better knowledge as to be model students, stimulating and encouraging those around them by their example as much as by their teaching. Young men do not prepare themselves in any numbers for such a career :—

(1). Because the chief influences which surround them at school and at college are not calculated to awaken in them a desire to obtain excellence of such kind.

(2). Because they could not expect by means of such qualities to reach a position which would afford a competent subsistence.

Let these conditions be reversed, to the extent that existing teachers have powerful inducements to make their students love the study of science for its own sake, with just confidence that they will be able to earn a livelihood if they succeed in qualifying themselves to advance science, and the whole thing is changed. The first batch of young investigators will be dispersed among schools and colleges according to their powers and acquirements, and will at once improve their influence upon the pupils, and enable them to send up a second batch better trained than the first. This improvement will go on increasing, if the natural forces which promote it are allowed free play; and the youth of each successive generation will have better and more frequent opportunities of awakening to a love of learning, better help and guidance in their efforts to acquire and use the glorious inheritance of knowledge which had been left them, better and more numerous living examples of men devoting their whole lives to the extension of the domain of truth, and seeking their highest reward in the consciousness that their exertions have benefited their fellow men, and are appreciated by them.

A young man who is duly qualified for the work of teaching the investigation of some particular branch of science, and who wishes to devote himself to it, will become a member of an association of men selected for their known devotion to learning, and for their ability to teach the methods of investigation in their respective subjects. Around this central group is arranged a frequently changing body of youths, who trust to them for encouragement and guidance in their respective studies.

Our young investigator finds it necessary to study again more carefully many parts of his subject, and to examine accurately the evidence of various conclusions which he had formerly adopted, in order that he may be able to lead the minds of his pupils by easy and natural, yet secure, steps to the discovery of the general truths which are within their reach. He goes over his branch of science again and again from the foundation upwards, striving each time to present its essential particulars more clearly and more forcibly, arranging them in the order best calculated to stimulate an inquiring mind to reflect upon their meaning, and to direct its efforts effectively to the discovery of the general ideas which are to be derived from them. He is encouraged in these efforts by the sympathy of his colleagues, and often aided by suggestions derived from their experience in teaching other branches of science, or by information respecting doctrines or methods which throw a light upon those of his own subject.

No known conditions are so well calculated to give a young investigator the closest and strongest grasp of his subject of which he is capable as those in which he is placed while thus earnestly teaching it in a college; and inasmuch as a thorough mastery of known truths is needed by every one who would work to advantage at the discovery of new truths of that kind, it will, in most cases, be an object of ambition to the ablest young investigators to get an opportunity of going through the work of teaching in a college, in order to improve themselves to the utmost for the work of original research. There is, however, another advantage to them in having such work to do; for the best way to ascertain at any one time what additions may be made to a science, is to examine the facts which have been discovered last, and to consider how far they confirm and extend the established ideas of the science, how far they militate against those ideas. An investigating teacher is constantly weaving new facts into the body of his science, and forming anticipations of new truths by considering the relation of these new facts to the old ones.

When our investigator has thus got a thorough mastery of his science and new ideas for its extension, he ought to have the opportunity of turning his improved powers to account by devoting more of his time to original research; in fact he ought to teach research by example more than hitherto, and less by elementary exercises upon known facts. If he has discharged the duties of his first post with manifest efficiency, he will be promoted, either in his own or some other college, to a chair affording more leisure and facility for original research by his own hands and by those of his assistants and pupils. Some investigators may find it desirable to give up after a while all teaching

of previously published truths, and confine themselves to guiding the original researches of advanced pupils, while stimulating them by the example of their own discoveries. But most of them will probably prefer to do elementary teaching work from time to time, for the sake of the opportunity of going over the groundwork of their science, with a knowledge of the new facts and enlarged ideas recently established.

Now it must be observed that such a system as the above, once developed to its proper proportions, so as to send annually to secondary schools many thousands of poor children who would otherwise never enjoy such advantages, and so as to train to original investigation a corresponding proportion of them, would not only provide more young investigators than would be needed for systematic teaching functions, but would also give a partial training of the same kind to many whose abilities proved to be insufficient, or whose tastes were not congenial to such pursuit. Some would be tempted by an advantageous opening in an industrial pursuit or in the public service to break off their studies before completion, and others would find, after completing their training, a position of that kind more desirable or more attainable than a purely scientific appointment. Not only would much good of other kinds be accomplished by this circumstance, but we may say with confidence that the system could not work with full advantage for its own special purpose of promoting the advancement of science if it did not diffuse a knowledge of the truths and methods of science beyond the circle of teachers.

There is an urgent need of accurate scientific knowledge for the direction of manufacturing processes, and there could not be a greater mistake than to suppose that such knowledge need not go beyond the elementary truths of science. In every branch of manufacture improvements are made from time to time, by the introduction of new or modified processes which had been discovered by means of investigations as arduous as those conducted for purely scientific purposes, and involving as great powers and accomplishments on the part of those who conducted them.

Any manufacturer of the present day who does not make efficient arrangements for gradually perfecting and improving his processes ought to make at once enough money to retire; for so many are moving onwards in this and other countries, that he would soon be left behind.

It would be well worth while to establish such a system of scientific education for the sake of training men to the habits of mind which are required for the improvement of the manufacturing arts; and I have no doubt that the expense of working the system would be repaid a hundred times over by the increase of wealth of the community; but I only mention this as a secondary advantage of national education.

A system of the kind could not expand to due dimensions, nor could it, once fully established, maintain itself in full activity, without intelligent sympathy from the community; and accordingly its more active-minded members must be taught some good examples of the processes and results of scientific inquiry, before they can be expected to take much interest in the results achieved by inquirers, and to do their share of the work requisite for the success of the system. I need hardly remind you that there are plenty of other strong reasons why some such knowledge of the truths of nature, and of the means by which they are found out, should be diffused as widely as possible throught the community.

You perceive that in such educational system each teacher must trust to his own exertions for success and advancement; and he will do so if he is sure that his results will be known and compared impartially with those attained by others. Each governing body must duly maintain the efficiency of their school or college, if its support depend in some degree on the evidences of that efficiency; and they will try to improve their school if they know that every improvement will be seen and duly appreciated.

The key-stone of the whole structure is the action of the State in distributing funds carefully among schools and colleges proportionally to the evidence of their doing good work, which could not be continued without such aid.

I am inclined to think that the State ought, as far as possible, to confine its educational grants to the purpose of maintaining and continuing good work which is actually being done, and rarely, if ever, to initiate educational experiments: first, because it is desirable to encourage private exertions and donations for the establishment of schools and colleges upon new systems, or in new localities, by giving the public full assurance that if any new institution establishes its right to existence, by doing good work for a while, it will not be allowed to die off for want of support; and, secondly, because the judicial impartiality required in the administration of public funds, on the basis of results of work, is hardly compatible with an advocacy of any particular means of attaining such results.

On the other hand, experience has shown that special endowments, which tie up funds in perpetuity for a definite purpose, commonly fail to attain their object under the altered circumstances which spring up in later generations, and not unfrequently detract from the efficiency of the institutions to which they are attached, by being used for objects other than those which it is their proper function to promote.

When there is felt to be a real want of any new institution for the promotion of learning, men are usually willing enough to devote time and money to the purpose of establishing it and giving it a fair trial. It is desirable that they should leave the State to judge of their experiment by its results, and to maintain it or not, according to the evidence of its usefulness. No institution ought, for its own sake, to have such permanent endowments as might deprive its members of motives for exertion.

The State could not, however, discharge these judicial functions without accurate and trustworthy evidence of the educational work done at the various schools and of its success. For this purpose a record must be kept by or under the direction of every teacher of the weekly progress of each pupil, showing what he has done and how he has done it. Official inspectors would have to see to these records being kept upon a uniform scale, so that their results might be comparable. The habit of keeping such records conduces powerfully to the efficiency of teachers; and, for the sake of the due development of the teaching system, it ought to prevail generally. Having such full and accurate means of knowing what opportunities of improvement pupils have enjoyed, and what use they have made of those opportunities, Government ought to stimulate their exertions and test their progress by periodical examinations. It is of the utmost importance to allow any new and improved system of instruction to develop itself freely, by the exertions of those who are willing to undertake the labour and risk of trying it on a practical scale; and the pupils who acquire upon such new system a command of any branch of science, ought to have a fair opportunity of showing what they have achieved and how they have achieved it. An able and impartial examiner, knowing the new systems in use, will encourage each candidate to work out his results in the manner in which he has been taught to work out results of the kind.

Examinations thus impartially conducted with a view of testing the success of teachers in the work which they are endeavouring to do, have a far higher value, and consequent authority, than those which are conducted in ignorance or disregard of the process of training to which the candidates have been subjected; and we may safely say that the examination system will not attain its full usefulness until it is thus worked in intimate connection with a system of teaching.

In order to give every one employed in the educational system the utmost interest in maintaining and increasing

his efficiency, it is essential that a due measure of publicity be given to the chief results of their respective labours. Schools and colleges ought, to a considerable extent, to be supported by the fees paid by pupils for the instruction received; and every professor being in part dependent upon the fees of his pupils will have a direct interest in attracting more pupils to his classes or laboratories. The fame of important original investigations of his own or his pupils, published in the scientific journals, is one of the natural means by which a distinguished professor attracts disciples, and the success of his pupils in after life is another. His prospects of promotion will depend mainly on the opinion formed of his powers from such materials as these by the governing bodies of colleges and by the public; for if each college is dependent for success upon the efficiency of its teaching staff, its governing body must do their best to fill up every vacancy as it arises by the appointment of the ablest and most successful professor whom they can get; and any college which does not succeed in obtaining the services of able men will soon lose reputation, and fall off in numbers.

There are, however, further advantages to the working of the system to be derived from full publicity of all its more important proceedings. It will supply materials for the formation of a sound public opinion respecting the proceedings of the authorities in their various spheres of action. A claim for money might be made upon Government by the rulers of some college upon inadequate grounds; or a just and proper claim of the kind might be disregarded by Government. Neither of these things will be likely to happen very often if the applications, together with the evidence bearing on them, are open to public scrutiny and criticism; and when they do occasionally happen, there will be a natural remedy for them.

If I have succeeded in making clear to you the leading principles of the plan to be adopted for the advancement of science, including, as it necessarily must do, national education generally, you will, I think, agree with me that, from the very magnitude and variety of the interests involved in its action, such system must of necessity be under the supreme control of Government. Science will never take its proper place among the chief elements of national greatness and advancement until it is acknowleged as such by that embodiment of the national will which we call the Government. Nor can the various institutions for its advancement develop duly their usefulness until the chaos in which they are now plunged gives place to such order as it is the proper function of Government to establish and maintain.

But Government has already taken, and is continuing to take, action in various matters affecting elementary popular education and higher scientific education, and it would be difficult to arrest such action, even if it were thought desirable to do so. The only practical question to be considered is how the action of Government can be systematised so as to give free play to the natural forces which have to do the work.

By establishing official examinations for appointments and for degrees, Government exerts a powerful influence on the teaching in schools and colleges, without taking cognisance, except in some few cases, of the systems of teaching which prevail in them. Again, they give grants of public money from time to time in aid of colleges or universities, or for the establishment of a high school under their own auspices. Sometimes they endow a professorship. In taking each measure of the kind they are doubtless influenced by evidence that it is in itself a good thing, calculated to promote the advancement of learning. But a thing which is good in itself may produce evil effects in relation to others, or good effects incommensurate with its cost. Thus examinations afford most valuable aid to educational work when carried on in conjunction with earnest teachers; yet, when established in the absence of a good system of education, they are liable to give rise to a one-sided training contrived with a special view of getting young men through the examinations, If no properly educated young men were found for a particular department of the public service, and an examination of all candidates for such appointments were to be established for the purpose of improving the system of training, candidates would consider their power of answering such questions as appeared likely to be set as the condition of their obtaining the appointments, and they would look out for men able and willing to train them to that particular work in as direct and effective a manner as possible. The demand for such instruction would soon be supplied. Some teachers would undertake to give instruction for the mere purpose of enabling candidates to get through the examination, and, by the continued habit of such work, would gradually come to look upon the examiners as malignant beings who keep youths out of office, and whose vigilance ought to be evaded by such means as experience might show to be most effective for the purpose. Once this kind of direct examination-teaching has taken root, and is known to produce the desired effect of getting young men through the examinations, its existence encourages the tendency on the part of the candidates to look merely to the examination as the end and aim of their study; and a class of teachers is developed whose exertions are essentially antagonistic to those of the examiners.

There are, no doubt, teachers with a sufficiently clear apprehension of their duty, and sufficient authority, to convince some of the candidates that the proper object of their study should be to increase their power of usefulness in the career for which they are preparing themselves, by thoroughly mastering up to a prescribed point certain branches of knowledge; and that, until they had honestly taken the means to do this, and believed they had done it effectually, they ought not to go up for examination, nor to wish to commence their career.

But it is desirable that all teachers be placed under such circumstances that it may become their interest as well as their duty to co-operate to the utmost of their powers in the object for which the examiners are working. For this purpose their records of the work done under their guidance by each pupil ought to be carefully inspected by the examiners before framing their questions, and ought to be accepted as affording the chief evidence of the respective merits of the pupils.

This is not the place for considering how the general funds for an effective system of national education can best be raised, nor how existing educational endowments can best be used in aid of those funds. It is well known that some colleges of Oxford and Cambridge are possessed of rich endowments, and that many distinguished members of those universities are desirous that the annual proceeds of those endowments should be distributed upon some system better calculated to promote the advancement of learning than that which generally prevails. Indeed we may confidently hope that, true to their glorious traditions, those colleges will be led, by the high-minded and enlightened counsels of their members, to rely upon improving usefulness in the advancement of learning as the only secure and worthy basis of their action in the use of their funds, so that they may take a leading part in such system of national education as may be moulded out of the present chaos.

But the foundations of a national system of education ought to be laid independently of the present arrangements at Oxford and Cambridge, for we may be sure that the more progress the system makes the more easy will become the necessary reforms in the older universities and colleges.

It is clearly undesirable that Government should longer delay obtaining such full and accurate knowledge of the existing national resources for educational purposes, and of the manner in which they are respectively utilised, as may enable them to judge of the comparative prospects of usefulness presented by the various modes of distributing educational grants. They ought to know what has been done and what is doing in the various public educational

establishments before they can judge which of them would be likely to make the best use of a grant of public money.

We have official authority for expecting such impartial administration of educational grants; and it cannot be doubted that before long due means will be taken to supply the preliminary conditions.

You are no doubt aware that a Royal Commission was appointed some time ago in consequence of representations made to Government by the British Association on this subject, and it is understood that their instructions are so framed as to direct their particular attention to the manner in which Government may best distribute educational grants. The Commission is moreover composed of most distinguished men, and we have every reason to anticipate from their labours a result worthy of the nation and of the momentous occasion.

In speaking of public educational establishments, I refer to those which by their constitution are devoted to the advancement of learning without pecuniary profit to their respective governing bodies. The annual expenditure requisite for keeping up a national system of popular education will necessarily be considerable from the first, and will become greater from year to year; but once Englishmen are fully alive to the paramount importance of the object, and see that its attainment is within their reach, we may be sure that its expense will be no impediment. England would not deserve to reap the glorious fruits of the harvest of knowledge if she grudged the necessary outlay for seed and tillage, were it even ten times greater than it will be. It is no use attempting to establish a national system on any other than a truly national basis. Private and corporate funds inevitably get diverted from popular use, after a few generations, to the use of the influential and rich. A national system must steadily keep in view the improvement of the poor, and distribute public funds each year in the manner best calculated to give the youths of the poorest classes full opportunities of improvement proportional to their capacities, so that they may qualify themselves for the utmost usefulness to their country of which they are capable. The best possible security for the proper administration of the system will be found in the full and speedy publicity of all the particulars of its working.

It has been frequently remarked that a great proportion of English investigators are men of independent means, who not only seek no advancement as a reward of their labours, but often sacrifice those opportunities of improving their worldly position which their abilities and influence open up to them, for the sake of quietly advancing human knowledge. Rich and powerful men have very great temptations to turn away from science, so that those who devote their time and money to its service prove to us how true and pure a love of science exists in this country, and how Englishmen will cultivate it when it is in their power to do so.

Now and then a youth from the poorer classes is enabled by fortunate accidents and the aid of a friendly hand to climb to a position of scientific activity, and to give us, as Faraday did, a sample of the intellectual powers which lie fallow in the great mass of the people.

Now, the practical conclusion to which I want to lead you is, that it rests with you, who represent the national desire for the advancement of science, to take the only measures which can now be taken towards the establishment of a system of education worthy of this country, and adapted to the requirements of science. In the present stage of the business the first thing to be done is to arouse public attention by all practicable means to the importance of the want, and to get people gradually to agree to some definite and practicable plan of action. You will, I think, find that the best way to promote such agreement is to make people consider the natural forces which have to be systematised by legislation, with a view of enabling them to work freely for the desired purpose. When the conditions essential to any national system come to be duly appreciated by those interested in the cause of education, means will soon be found to carry out the necessary legislative enactments.

The highest offices in the State are on our present system filled by men who, whatever their political opinions and party ties, almost infallibly agree in their disinterested desire to signalise their respective terms of office by doing any good in their power. Convince them that a measure desired by the leaders of public opinion is in itself good and useful, and you are sure to carry it.

And, on the other hand, England is not wanting in men both able and willing to come forward as the champions of any great cause, and to devote their best powers to its service.

I may well say this at Bradford after the results achieved by your Member in the Elementary Education Act.

Objections will, of course, be raised to any system on the score of difficulty and expense, more especially to a complete and good system. Difficult of realisation it certainly must be, for it will need the devoted and indefatigable exertions of many an able and high-minded man for many a long year. Only show how such exertions can be made to produce great and abiding results, and they will not be wanting. And as for expense, you will surely agree with me that the more money is distributed in such frugal and effective manner, the better for the real greatness of our country.

What nobler privilege is attached to the possession of money than that of doing good to our fellow men? and who would grudge giving freely from his surplus, or even depriving himself of some comforts, for the sake of preparing the rising generation for a life of the utmost usefulness and consequent happiness?

I confidently trust that the time will come when the chief item in the annual budget of the Chancellor of the Exchequer will be the vote for National Education; and when in some later age our nation shall have passed away, when a more true civilisation has grown up and has formed new centres for its throbbing life, when there are but broken arches to tell of our bridges and crumbling ruins to mark the sites of our great cathedrals—then will the greatest and noblest of England's works stand more perfect and more beautiful than ever; then will some man survey the results of Old England's labours in the discovery of imperishable truths and laws of nature, and see that her energy and wealth were accompanied by some nobler attributes—that while Englishmen were strong and ambitious enough to grasp power, they were true enough to use it for its only worthy purpose, that of doing good to others.

I must not, however, trespass longer upon your time and your kind attention. My subject would carry me on, yet I must stop without having half done justice to it.

If I have succeeded in convincing you that a National system of Education is now necessary and possible, and in persuading you to do what you respectively can to prepare the way for it, I shall feel that the first step is made towards that great result.

SECTION B.—CHEMICAL SCIENCE.

For the benefit of those of our readers who were prevented from attending the 1873 meeting of the Association we print short abstracts of the papers read before the Chemical Section, with a condensed report of the discussions. Those papers which are of sufficient importance will be inserted in full as quickly as our space will permit.

"*Report on the Chemical Constitution and Optical Properties of Essential Oils.*"—The report consisted of a *resumé* of the results obtained during the previous year's work, in continuation of the work described in previous reports. The products of the actions of nitric acid on hesperidin, and the terpen present in oil of nutmegs (hesperisic and myristisic acids, &c.), were described, the conclusion drawn being that oil of turpentine, oil of nutmegs, and hesperidin are the different isomerides: some

probable inferences were also made as to the connections between the nature of isomerism and the *intrinsic chemical energy* of the different isomerides severally. The action of bromine on the oil of nutmeg and on hesperidin is the same as that on turpentine—namely, combination, the resulting dibromide being split up by heat into hydrobromic acid and cymen. The two varieties of cymen thus obtained were carefully compared with cymen from other sources—namely, the action of zinc chloride on myristicol; the action of heat on the product of the action of phosphorus pentachloride on myristicol, and that of phosphorus pentachloride on camphor; also with the cymen isolated from oil of turpentine and from crude nutmeg terpen; the terpen present by sulphuric acid, and that from oil of cummin. All these gave the same results on oxidation (terepthalic acid and acetic acid free from other products), had the same boiling-point (close to 176·5 in each case), and had had the sp. gr. 0·860, the specific dispersion 0·0405, and the refraction equivalent 75·0, and from this it is inferred that there is but one kind of cymen as yet known, and not two, as supposed by some chemists. The oil of citronella has also been partially examined; it consists essentially of a substance having the composition of $C_{10}H_{18}O$; by the action of dehydrating agents it splits up into water and a terpen $C_{10}H_{16}$; and when bromine is added to it the resulting product breaks up, on heating, into water, hydrobromic acid, and cymen, apparently identical with the other samples examined.

Dr. GLADSTONE: One very interesting point that rose in this investigation was the refraction equivalent of the isomeric bodies of the composition $C_{10}H_{16}O$, when the carbon atoms combined with nearly, but not quite, two equivalents of hydrogen, or a corresponding amount of some other element. At present the evidence is in favour of these isomeric bodies not having the same influence on light, which may serve to explain the difference of their rational composition or structure.

"*On Black Deposits on Metals*," by J. H. GLADSTONE, F.R.S.—If a piece of metal be immersed in the solution of another metal which it can displace, the latter metal immediately makes its appearance at myriads of points in a condition that does not reflect light; but as the most favourably circumstanced crystals grow, they acquire the optical properties of the massive metal, the period at which the change takes place depending partly on the nature of the metal and partly on the rapidity of its growth. This was illustrated in the case of platinum, palladium, iridium, bismuth, antimony, gold, copper, lead, silver, thallium, zinc, and cadmium. If zinc be immersed in a solution of copper sulphate, the black deposit is first copper, then some black zinc is deposited on the copper, as first shown by Dr. Russell, then this zinc is more or less oxidised; and according to the stage arrived at in this action is the ease with which a metallic streak is obtained on pressure, and the colour of the streak.

Dr. RUSSELL asked whether Dr. Gladstone had ever obtained a black deposit of copper absolutely free from zinc.

Dr. THORPE had employed the copper zinc couple of Messrs. Gladstone and Tribe for reducing nitric acid, and found that the black deposit alone was effective; hence he concluded it contained zinc.

Dr. GLADSTONE fully admitted that practically there was always more or less zinc in the black deposit of the couple, but it might be obtained at first with no perceptible amount of that metal, and the zinc of the washed black deposit might be removed by treating it with sulphate of copper, when it would still remain black.

"*On a Specific Gravity Bottle for Inflammable Liquids*," by A. TRIBE, F.C.S.—This consisted in a modification of that of Regnault, the narrow neck being graduated, instead of one mark being made in it. The advantage was that an inflammable liquor, or one that gave dense or injurious fumes in the air, might be quickly poured in without observing the particular height in the neck till the stopper had been inserted. It also afforded the opportunity of bringing the liquor to a desired temperature after it was in the bottle. Of course the value of the graduations must be determined.

"*On Derivatives of Codeine and Morphine*," by C. R. A. WRIGHT, D.Sc., F.C.S.—This paper was a *resumé* of results obtained during the previous year in continuation of those brought before the Association on former occasions. Morphine gives rise, by treatment with sulphuric acid, to polymerides precisely analogous to those found from codeine under similar conditions; trimorphine and tetramorphine have been isolated, but dimorphine has not yet been found. Derivatives from these bodies by the action of hydrochloric acid have been obtained and studied. The sulphomorphide of Laurent and Gerhardt is only tetramorphine sulphate. By the action of hydrochloric acid on morphine a chlorinated product is formed; by further treatment this forms apomorphine and a new body. Under the same circumstances codeine gives rise to a chlorinated base, homologous with that from morphine; the further action gives rise, not to apomorphine, but a somewhat similar body containing more of the elements of water, *i.e.*, intermediate between morphine and apomorphine. The action of zinc chloride on morphine has also been studied; the final products are apomorphine and an isomeric base of the tetra series, intermediate substances being found. The physiological properties of most of these new derivatives have been studied and some connections made out in certain cases between the composition and the physiological action.

A brief discussion followed, in which Drs. ARMSTRONG and MILLS took part.

INVESTIGATION OF THE FLUORESCENT AND ABSORPTION SPECTRA OF THE URANIUM SALTS.*

By HENRY MORTON, Ph.D.,
and H. CARRINGTON BOLTON, Ph.D

(Continued from p. 116).

PART III.

PASSING now to the detailed discussion of the various compounds, we will take these up in alphabetical order for the convenience of reference.

Uranic Acetates.

Uranic acetate combines with acetates of the bases RO to form a very large number of double salts. Of these there have been described, up to the present time, the following, including the uranic acetate, which may be considered as the starting-point:—

$U_2O_3.C_4H_3O_3 + 2HO$
$2(U_2O_3.C_4H_3O_3) + NaO\ .C_4H_3O_3$
$2(U_2O_3.C_4H_3O_3) + KO\ .C_4H_3O_3 + 2HO$
$2(U_2O_3.C_4H_3O_3) + NH_4O.C_4H_3O_3 + 6HO$
$2(U_2O_3.C_4H_3O_3) + LiO\ .C_4H_3O_3 + 6HO$
$2(U_2O_3.C_4H_3O_3) + CaO\ .C_4H_3O_3 + 8HO$
$2(U_2O_3.C_4H_3O_3) + BaO\ .C_4H_3O_3 + 2HO$
$2(U_2O_3.C_4H_3O_3) + SrO\ .C_4H_3O_3 + 6HO$
$2(U_2O_3.C_4H_3O_3) + MgO\ .C_4H_3O_3 + 12HO$
$2(U_2O_3.C_4H_3O_3) + ZnO\ .C_4H_3O_3 + 7HO$
$U_2O_3.C_4H_3O_3 + CdO\ .C_4H_3O_3 + 5HO$
$U_2O_3.C_4H_3O_3 + PbO\ .C_4H_3O_3 + 6HO$
$2(U_2O_3.C_4H_3O_3) + AgO\ .C_4H_3O_3 + 2HO$
$2(U_2O_3.C_4H_3O_3) + MnO\ .C_4H_3O_3 + 12HO$
$2(U_2O_3.C_4H_3O_3) + CoO\ .C_4H_3O_3 + 7HO$
$2(U_3O_3.C_4H_3O_3) + NiO\ .C_4H_3O_3 + 7HO.$

To these we have added the following, which have not before been described:—

$n(U_2O_3.C_4H_3O_3) + HlO,\ C_4H_3O_3 + HO$
$n(U_2O_3\ C_4H_3O_3) + RbO, C_4H_3O_3 + 1HO;$

* Communicated by President Morton.

also the anhydrous uranic acetate, $U_2O_3C_4H_3O_3$, which we have prepared and studied.

It will be observed that in all of these compounds two molecules of uranic acetate combine with one molecule of the acetate of RO, except in the case of the salts of lead and of cadmium in which the ratio is 1 : 1.

Most of these salts crystallise very readily from acid solutions of equivalent weights of the mixed acetates; they vary considerably in stability, some, like the sodio-acetate, suffering no change at a temperature of 200° C., and others, like the plumbo-uranic acetate, decomposing at 100° C., or the argento-uranic acetate, which decomposes at 70° to 80° C., or by exposure to sunlight.

Some crystallise out, on cooling, warm concentrated solutions, while others, as the lithium salt, are only obtained by evaporation over sulphuric acid.

On boiling solutions of these salts containing no free acid, uranates of the respective bases precipitate, and in many cases the same happens to a neutral solution on standing even in the cold.

All these salts we have prepared in a state of chemical purity, and have thoroughly examined as to their spectra of fluorescence and absorption, and have likewise studied the effects of heat in either temporarily or permanently modifying their properties in these connections.

In the course of these examinations we have recognised the existence of more than one hydrate of the same salt, which enables us to explain some of the discrepancies of authorities on this point.

Uranic Acetate (*normal*), $U_2O_3C_4H_3O_3+2HO$.

This substance fluoresces very brightly, different specimens, however, differing greatly in this respect, probably from the presence in certain cases of minute traces of foreign matter. Its solution also yields a very bright fluorescence, exceeding that of the nitrate, which is, however, decidedly reduced by the addition of a very minute quantity of alcohol, ether, glucose, or sucrose, and is destroyed by a very small amount of hydrochloric acid. The fluorescent light of the solution yields a continuous spectrum.

When examined with the spectroscope its fluorescent light emitted by the solid yields a system of eight bands. Of these the 1st and 7th are very faint, and the 8th only appreciable with a strong light and wide opening to the slit of the spectroscope.

The brighter bands will show a very abrupt termination towards the more refrangible end, and shade off gradually so as to look like a series of short pieces of moulding illuminated from the violet side of the spectrum. No. 1 in Fig. 5 will give an idea of this, as well as of the positions of the various bands.

Measuring the edge of the bright bands at their upper or abrupt side, we get the following as the average of several sets of observations:—

Bands:—1.	2.	3.	4.	5.	6.	7.
37·0	43·8	51·6	60·7	70·4	80·2	90·0

The 8th band is too faint to show any definition on its edge, if it has any, and its measurement was therefore made at its brightest part, giving 90·6.

By turning the spectroscope obliquely on the bottle containing this salt, an absorption band at 107 can be distinguished with tolerable ease, but none above this can be well made out, and in fact, as regards this matter, the strongest contrast exists between the uranic acetates and its double salts. By crushing a few grains to a fine powder, with a little water, between slips of glass, we may, however, observe the absorption bands by transmitted light with reasonable facility, and then get a spectrum of a very curious character as regards the irregular spacing of its bands. No. 1 of Fig. 6 will give a good idea of this. Another noteworthy point is the very strong general absorption, which almost obliterates details of the spectrum, and makes it impossible to recognise any bands above one at about 135.

In solution this general absorption is decidedly increased, and the absorption bands are blended so that little can be done in the way of measuring them with ordinary means: we shall see, however, presently that this condition affords an important means of discrimination.

If we make a solution of the neutral acetate in water, and examine its absorption, we shall find a faint band at about 105, and some indication of one at about 117, but a very heavy general absorption over the entire region above the first-named band obliterating all variations of shade.

The addition of a little acetic or other strong acid will, however (while destroying the fluorescence of the solution), clear up its absorption spectrum in a remarkable manner, giving us such a one as is shown at No. 3 of Fig. 6, which we have reasons for regarding as the absorption spectrum of *the double acetate of uranium and water*. These reasons will be stated further on, when the necessary preliminary facts have been reviewed.

Fig. 5.

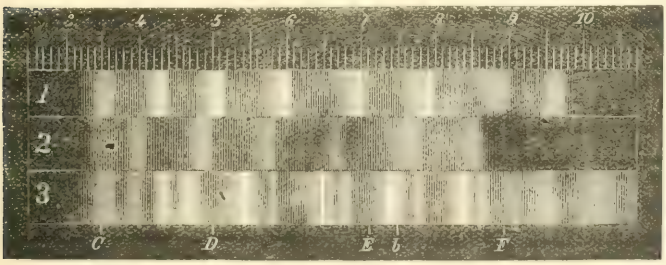
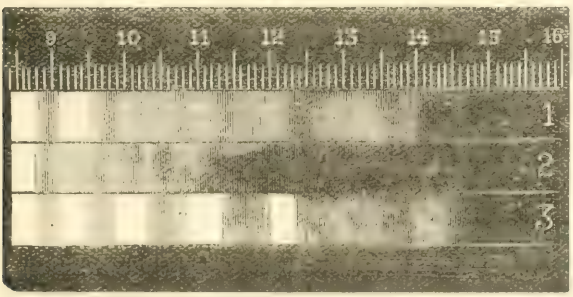


Fig. 6.



Anhydrous Uranic Acetate, $U_2O_3C_4H_3O_3$.

If the above normal uranic acetate is dried in a hot-water oven, at a temperature of 100° C., for some hours, it becomes opaque, and of a lighter and purer yellow tint, and on examination is found to yield a fluorescent spectrum, the bands of which are like those of the normal salt, but are all displaced downward in the spectrum. No. 2 of Fig. 5 will show the arrangement of these bands. The brightness of the fluorescence is very much reduced, and probably for this reason—the first and last bands could not be made out with the apparatus at present in use.

By inclosing this substance in dry powder, between slips of glass, its absorption spectrum was observed with transmitted light, and is shown at No. 2 of Fig. 6. The general absorption is, however, even greater in this than in the case of the normal uranic acetate, and

thus the recognition of the higher bands is more difficult.

The Double Acetates.

The double acetates of uranium, as a class, give spectra which—while differing in a marked manner from that of the simple uranic acetate—have the most striking resemblance among themselves.

The fluorescent spectrum of the sodio-uranic acetate, shown in No. 3 of Fig. 1, is a type of a perfect double acetate spectrum, others differing from it only by lacking some of the fainter bands, and by some slight general displacement of all the bands up and down in the spectrum.

Taking the sodio-acetate, whose bands stand highest in the spectrum, as head of the list, the acetates would arrange themselves in the following order, noting for brevity simply the symbols of the distinguishing elements—Na, Li, K, Sr, Mg, Am, Zn, Rb, Il, Ba, Cd, Pb, Ca, Ni, Mn. At the same time it must be noted that between Am and Cd the progressive change is so gradual that the exact order cannot be insisted upon between any adjacent two, or even three in some cases.

The absorption spectra of the acetates, of which also that of the sodio-uranic acetate may be taken as the type, shift, as do their fluorescent spectra, marking again the very close relation which exists between these phenomena, while at the same time their independence is illustrated by the fact that in such cases as that of the bario-uranic acetate, where the fluorescence is exceedingly weak, and the cobalto-uranic acetate, where it is absent all together, the absorption spectrum is as well developed as in any other case.

All the double acetates, in fact, show their absorption spectra with very great ease, and most of the bands can be seen by simply directing the spectroscope obliquely towards the bottle containing the salt under examination, when the apparatus is arranged for the study of the absorption bands.

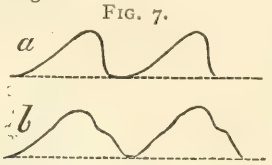
Sodio-Uranic Acetate,

$$2(U_2O_3.C_4H_3O_3)+NaO.C_4H_3O_3.$$

This is the most brilliantly fluorescent of the uranic acetates, and yields a spectrum which it is easy to examine accurately, as a very narrow slit may be employed.

This spectrum differs entirely from that of the uranic acetate in several particulars. In the first place it has no abrupt or sharply defined termination to its bands, as has the simple acetate towards the more refrangible edge, and in the second place it has a decided secondary inflection of brightness on what may be called the upper flank of each band. Thus, if we were to represent these inflections of light by profiles, that of the acetate bands would be indicated by *a*, and those of the soda salt by *b* of the adjacent figure.

Fig. 7.



The positions of these bands as compared with those of the uranic acetate amounts to an upward displacement which brings them into the spaces between the others, and this, combined with their difference of character, produces a compound spectrum of singular beauty. The presence of this double spectrum reveals to us at a glance in most of the commercial uranic acetates the presence of the soda salt which is *not* specified on the label.

Another characteristic of the sodio-uranic acetate spectrum and of the double acetates generally, is that the space corresponding to the two lowest groups or bands is occupied by four narrow bands quite different in character from all above. This is well shown in No. 3 of Fig. 5, which represents at once the spectrum of this salt and of the hydro-uranic acetate, as we might call it, mentioned before.

The absorption spectrum of this salt is like others of its class, beautifully regular and well defined, being but little obscured by the general absorption which so often conceals the bands in other cases.

Each band is, moreover, composite in its structure, consisting of a narrow and abruptly terminated line, bordered by a much fainter shade, see No. 3, Fig. 6.

If we now examine the solution of this salt in a neutral state, we shall find exactly the same bright fluorescence, yielding a continuous spectrum and the same heavy general absorption with two obscure bands, that we noticed with the neutral uranic acetate. Moreover, if we add a strong acid, the fluorescence will be destroyed, and the spectrum cleared up exactly as with the above-named salt, and what is more, we shall find the same true for every one of the seventeen double acetates which we have so far examined. This spectrum, moreover, as regards the position and character of its bands, is not to be distinguished from that of the dry or anhydrous sodio-uranic acetate.

In their solid state all these salts yield spectra more or less different from this in the position of their bands, but in solution they are all alike, and the inference seems irresistible that we see in all of these solutions the spectrum of the same body.

The question then arises, what is this body? Before answering this, let us review some of the facts—(1) To produce this spectrum acetic acid must be added or set free by the addition of some other acid able to liberate it; (2) The spectrum produced is sensibly identical with that of the *double acetate* of sodium and uranium; (3) Previous experiments in freezing solutions have shown us that no change in a spectrum is to be expected from the mere act of "mechanical solution."

With these points before us it certainly seems probable that the body whose spectrum is here shown is a *double acetate of uranium and water or a hydro-uranic acetate.*

This, as a consequence, brings with it the conclusion that the uranic double acetates do not exist as such in solution, and as we find evidence of a parallel character in the case of the oxychlorides, sulphates, carbonates, &c., we may probably enunciate with safety the conclusion that the uranic double salts generally break up in solution into their respective "hydrates," or double salts, in which water is one of the bases. Various collateral points support this general view. Thus, the cobalt double acetate shows no fluorescence whatever, but its neutral solution fluoresces as brightly as that of the simple uranic acetate.

Many of the double acetates decompose in solution and crystallise out as separate salts.

Others, again, if neutral, precipitate as uranates until enough acetic acid is set free to hold the remainder (according to the view here proposed) as hydro-acetates.

The fact that the soda salt would have the smallest amount of inert matter in comparison with the active uranium except the supposed water salt, and has the highest position for its bands of all the acetates, should not be overlooked.

We have already noticed the effect which heat produces in displacing the fluorescent bands of the sodio-uranic acetate downwards in the spectrum. A series of careful observations showed that the absorption bands followed the same law.

The following measures of three bands will indicate the amount of this displacement:—

Bands.	3.	4.	5.
24° C. (75° F.)	105·4	115·8	126·6
138° C. (280° F.) ..	103·8	114·2	125·0

The solution of sodio-uranic acetate fluoresces very brightly, and yields a continuous spectrum when its light is examined with the spectroscope.

At a temperature of 49° C. (120° F.) this fluorescence is sensibly reduced, and at 83° C. (181·4° F.) there is

hardly a trace left. The addition of small quantities of ether, alcohol, glucose, sucrose, and glycerin greatly reduce the fluorescence of this solution, and a very small amount of hydrochloric acid destroys it entirely, but the former bodies do not have any effect in clearing up the absorption spectrum, as has been before noticed with acids generally, in the case of the uranic acetate, which, indeed, we believe to be the body here concerned.

The positions of bands as observed in a number of the double acetates are given in the following tables, in which the substances are arranged in alphabetical order for convenience or reference. The distinctive part of the name only is given, and the reader will therefore supply the words "uranic acetate" after each of these prefixes :—

POSITIONS OF THE CENTRES OF ABSORPTION BANDS IN THE SPECTRA OF THE URANIC DOUBLE ACETATES.

Bands.	1.	2.	3.	4.	5.	6.	7.
Ammonio-	—	—	105·4	115·8	127·2	137·2	149·0
Bario- ..	—	—	105·0	115·0	125·3	137·0	149·0
Calcio- ..	—	93·7	103·0	113·8	124·4	136·0	147·4
Cadmio-	—	—	103·0	114·2	124·8	136·0	148·6
Cobalto-	—	—	104·6	115·0	125·0	137·2	148·6
Lithio- ..	—	—	105·4	115·8	126·6	136·8	148·6
Magnesio-	—	—	104·2	114·2	124·8	136·1	148·2
Mangano-	—	—	102·4	113·4	125·0	136·5	147·0
Nickelo-	—	—	103·0	113·8	125·0	136·0	148·0
Plumbo-	—	—	102·6	113·8	124·4	135·8	148·6
Potassio-	—	—	104·6	115·4	125·9	137·2	149·4
Rubidio-	—	94·1	104·6	115·0	126·6	136·8	148·6
Sodio- ..	39·2	96·0	105·4	116·0	127·2	138·8	150·6
Strontio-	—	—	104·2	114·2	125·0	136·5	149·0
Thallio-	—	—	103·8	114·2	125·9	136·5	148·2
Zinco- ..	—	—	103·0	113·4	124·4	135·0	146·7

POSITIONS OF THE CENTRES OF FLUORESCENT BANDS IN THE SPECTRA OF THE URANIC DOUBLE ACETATES.

Bands.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Ammonio-	—	—	41·6	46·2	54·0	62·8	71·8	82·0	92·0	101·0
Bario- ..	—	—	—	45·2	53·4	62·4	72·0	82·3	92·4	100·6
Calcio- ..	—	37·0	40·8	45·6	53·4	61·9	71·7	81·4	91·7	100·2
Cadmio- ..	—	36·2	48·0	44·6	53·8	62·8	71·3	81·8	92·0	100·6
Cobaltc-	No Fluorescence.									
Lithio- ..	—	—	42·4	46·0	54·3	63·3	71·9	82·0	93·7	102·6
Magnesio- ..	—	—	41·6	46·0	53·8	63·0	72·0	82·3	92·8	—
Mangano- ..	—	—	—	—	54·3	62·0	71·0	80·6	89·4	101·1
Nickelo- ..	—	—	—	45·2	53·0	62·0	70·8	81·4	91·3	100·6
Plumbo- ..	—	—	42·0	45·6	53·0	61·5	71·5	81·2	91·7	101·5
Potassio- ..	—	—	42·4	45·6	53·6	63·7	72·9	82·7	93·2	101·8
Rubidio- ..	—	—	—	—	53·8	63·3	72·0	82·6	93·2	—
Sodio- ..	36·0	40·0	41·0	48·0	56·3	64·0	73·8	83·8	94·4	103·8
Strontio- ..	—	—	—	46·0	54·3	63·3	72·9	81·4	92·0	—
Thallio- ..	—	—	—	45·6	53·4	62·8	71·7	82·7	92·0	—
Zinco- ..	—	—	42·0	45·6	54·3	63·3	72·0	81·8	92·4	—

Some special actions of certain salts require a further notice.

Thus, we found that when the magnesio-uranic acetate was allowed to crystallise in a desiccator it sometimes yielded crystals, which on exposure to a temperature of 100° lost a considerable amount of water and gave a continuous spectrum of fluorescence, and at others produced crystals which refused to part with any water at 100°, and when heated to a higher temperature lost water, but did not yield a continuous spectrum. Further investigation indicated that the first of these salts contained originally 12 atoms of water, and lost 4 atoms when dried at 100°, having, therefore, 8 atoms when it gave a continuous spectrum, and that the other salt contained originally 7 atoms of water.

These salts are still under investigation.

Wertheim gives the magnesio salt 8 atoms of water (*Journal fur Prakt. Chemie*, xxix., 207). Weselsky gives it 12 atoms, and says that over sulphuric acid it loses 6 atoms, changing it into the salt described by Rammelsberg in his *Kristollogr. Chemie*, supplement band, p. 142.

Further examination is needed to clear up these discrepancies, but the above observations throw some light on the subject.

The lead salt, if dried at 100°, loses 3HO, and ceases entirely to fluoresce; it will, however, dissolve in water, but unless a little acid is added soon deposits plumbic uranate.

The lithium salt, however, by drying at 100° C., loses 3 atoms or half its water, but has its fluorescence strengthened thereby.

A specimen of strontio-uranic acetate dried at 100°, acted like the magnesium salt before mentioned, *i.e.*, lost water and gave a contiuous spectrum.

The zinc acetate, by drying at 100° C., loses CHO, and acquires a spectrum exceedingly like that of the normal uranic acetate, though the bands are broader. It may therefore, perhaps, decompose and form that salt and zinc acetate, the latter losing all its water. It is, however, curious that the uranic acetate should retain its water, as it here seems to even when heated to 150°.

(To be continued.)

ON THE CHLORINATION AND IODINATION OF ANTHRACEN.

By THOMAS BOLAS.

Action of Antimony Pentachloride and Excess of Chlorine on Anthracen.

ONE part of anthracen and three parts of powdered antimony were placed in a retort and exposed to the action of a slow stream of chlorine. When the antimony was converted into pentachloride heat was applied, and the mixture was made to boil, chlorine being still passed into it. This digestion was continued for several days, it being at first intended to continue the chlorination until the evolution of hydrochloric acid ceased; but as this gas was set free, in small quantities, long after the principal reaction had evidently terminated, the digestion was finally stopped, and the contents of the retort were treated with dilute hydrochloric acid. The portion which remained undissolved was found to be very much carbonised and to present the appearance of fragments of spongy charcoal, but on subjecting it to dry distillation a sublimate was obtained which presented a crystalline appearance. This partially dissolved in hot benzene, and the solution deposited crystalline crusts on cooling: these crusts—after one, two, and three crystallisations from benzene—melted at 236°, 247°, and 252° respectively. As the yield of this substance was but small, there appeared no prospect of obtaining it in a pure state without first chlorinating a considerable quantity of anthracen. Consequently this body remains at present for further investigation. The portion of the crude sublimed product which did not dissolve in hot benzene proved to be almost insoluble in boiling acetic acid, but it yielded, on sublimation, beautiful yellowish needles resembling sublimed anthrachinon. These needles melted at a temperature above 330°, and they were found to be almost insoluble in alcohol, benzene, ligroïn, and carbon tetrachloride. The amount of chlorine contained in these crystals corresponded approximately with the formula $C_{14}Cl_6H_4$, but as the melting-point of this substance is so high, and considering that only a small proportion of it was obtained, I am inclined to regard it as derived from some foreign hydrocarbon contained in the anthracen employed. According to Fritzsche, anthracen melts at 210° to 212°, while dichloro-anthracen melts at 205°, and the melting-point of tetrachloranthracen is given as 220° by Graebe and Liebermann. Under these circumstances it would be surprising to find hexachloranthracen remaining unmelted at 330°. It is by no means improbable that the portion of the products which dissolves in hot benzene contains hexachloro-anthracen. This point I hope to elucidate shortly; and it is probable that, by employing a mixture of antimony chloride with some inert solvent, such as carbon tetrachloride, the violence of the action—especially that which takes place when the antimony first combines with chlorine—may be obviated, and that the carbonisation of the product may be considerably lessened.

Action of Iodine on Anthracen.

When anthracen is fused with excess of iodine, hydriodic acid is evolved, and on heating the mixture to its boiling-point the amount of hydriodic acid set free becomes considerable. If the mixture is now digested as long as hydriodic acid is evolved, and is then neutralised with soda, it will be found that the hydrocarbon has become transformed into a carbonised mass weighing rather more than the original anthracen. This charred mass, when heated in a tube, yields a small quantity of a sublimate consisting principally of free iodine, and it yields only a small portion of soluble matter to hot acetic acid or benzene. From this it is evident that the greater part of the anthracen is carbonised by long boiling with iodine.

In order to prevent the carbonisation of the greater part of the anthracen, 1 part of this hydrocarbon was carefully fused at 155° with 20 parts of iodine. As soon as the substances began to melt hydriodic acid was evolved, and when the fusion was complete and the materials were well mixed, the whole was cooled, powdered, and treated with soda solution. After the black residue had been washed and dried, it was extracted with boiling benzene, and it was found to yield a larger proportion of soluble matter than that obtained in the previous case, but the proportion not carbonised was still small.

When a solution of iodine in phenol (about 1 part to 6) is heated to its boiling-point no hydriodic is evolved, but if anthracen be added to the mixture, and heat be again applied, hydriodic acid is given off.

The facility with which iodine acts on anthracen is remarkable, and there can be but little doubt that the first step of the reaction consists in the formation of addition-compounds or substitution-compounds which are afterwards decomposed. Towards the solution of this point I am now directing my attention, and I hope, either by modifying the action of the iodine by means of a solvent, or by the action of iodine in conjunction with an oxidising agent, to obtain some definite results.

September 13, 1873.

NOTES AND QUERIES.

Black-Lead.—I should feel much obliged if you would kindly inform me, through the columns of your valuable paper, of the process the plumbago has to undergo to make it into cakes of "black-lead" for polishing stoves as sold by Nixey and others.—A COUNTRY SUBSCRIBER.

German Yeast.—I find the best Dutch distillers compose their grist in the proportion of 3 bushels of malt meal to 10 of rye meal; after fermentation, a considerable quantity of the meals and yeast will have settled to the bottom of the gyle tuns. Do the Germans, in making up their yeast for this country, add the settlings to the top yeast?—AROMA.

Action of Pyrogallate of Potash on Nitrous Oxide.—Having seen it generally stated that pyrogallate of potash had the power of absorbing *free* oxygen, and thus indicating the difference between mixtures and chemical compounds, it occurred to me to try its action on pure dry nitrous oxide. A cylinder of the gas was collected over mercury, and two glass bulbs of about 1 c.c. capacity introduced into the gas. One of the bulbs contained pyrogallic acid in solution, the other caustic potash. The cylinder was then closed with the thumb and shaken until the bulbs were broken, and then replaced with the mouth under the mercury. A few days after, the mercury not having risen in the tube, the gas in the cylinder was tested, and, to my surprise, instantly extinguished a taper, and in general reacted like nitrogen. Had the oxygen really been absorbed by the pyrogallate, the nitrogen would, of course, have occupied the original volume, since 2 vols. N_2O contain 2 vols. N. A second cylinder, filled at the same time, and treated with pyrogallate of potash as before, was left ten days over the mercury, then transferred to water. The water soon began to rise in the cylinder, and in ten days had absorbed 9-10ths of the gas. As nitrogen is not soluble in water, and nitrous oxide does not extinguish a taper, can some of your readers inform me what gas it was?—E. J. H., New York, August 29, 1873.

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SUPPLEMENT
TO
THE CHEMICAL NEWS.

Vol. XXVIII. No. 722.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, August 25, 1873.

M. Zöllner's Theory of Solar Scoriæ.—M. Faye.—This theory is, briefly, as follows:—The spots are scoriæ produced by local cooling of the incandescent liquid which forms the solar globe. Their relatively low temperature gives rise to currents analogous to those about our coasts and islands; only in the sun they do not alternate. The lower currents flow perpendicularly to the sides of the islet from within outwards; the upper from without inwards. Hence a continual series of vertical movements, the horizontal axes of which are *tangential* to the contours of the scoriæ. Naturally the solar radiation is partly suppressed by such an islet; and if the temperature sinks to the point of condensation of vapours in the atmosphere clouds are formed, whose figure depends on the upper currents flowing from all parts towards the vertical axis of the islet. They will especially be produced towards the central part, and the scoria will appear as a dark nucleus with its *enceinte* of penumbra. This local cooling, and the descending movement of the atmosphere towards the interior, will explain the depression observed at the dark nucleus of spots, and the effects of perspective as they approach the edge of the disc. If the ascending currents outside of the islet are strong they will leap up and give the appearance of ordinary protuberances. As to the eruptive protuberances, they are due to a local diminution of atmospheric pressure. The gases included and compressed, or simply dissolved in the liquid mass, escape like the gas-bubbles in seltzer water when the cork is drawn. The movements of spots are explained by "trade-winds" from the poles to the equator. The component of this action in the direction of the parallels diminishes the velocity of rotation, and retards the spots more in regions near the pole than at the equator, where the action is *nil*. Large scoriæ often break up and form several spots, the incandescent ocean appearing from below. Remarking on this theory M. Faye points out that the spots on nearing the edge ought, according to it, to show a projection at the side of the sort of vase of which the scoriæ forms the bottom: but there is nought of this, and the orifice becomes even with the edge of the disc. The depth of the spots has been measured, and found on an average three to four seconds. Everything indicates that the spots are cavities and not projections. On the other hand, the theory is more closely related to his (M. Faye's) own than P. Secchi's; both supposing a circulation and *down rush* of hydrogen; the axis, however, being according to the author vertical. And it is also preferable to the eruption theory in that it agrees with laws of movement of the spots, one of these being that each spot follows the movement of the parallel in which it is, and if it passes into another parallel takes the movement of that. But then one would suppose that the islets of scoriæ would be driven by the trade-winds supposed, towards the equator (like our ships). There is no such movement, and one even finds neighbouring spots which have limited movements in opposite directions, one towards the equator, the other towards the poles. The elliptic oscillation, too, has nothing in common with the displacement of floating bodies, and the phenomena of segmentation are hardly explained. The scoriæ (if such there were) would doubtless be formed in the hottest regions; but, on the contrary, they appear in the zones nearest the equator, never at the poles. The spots do not appear beyond the 35th degree of latitude, while the protuberances (supposed to be produced by them) appear as far as the 70th. Lastly, consider the long and constant solar radiation. The sun being simply a liquefied mass would have been long since encrusted. If the conductibility of liquids and solids is so small that these scoriæ resist the heat of the liquids for days, weeks, and even whole months, how are we to explain the enormous radiation of 1,200,000,000 calories per square metre of surface daily? A state of fluidity nearly gaseous is necessary to allow the play of ascending and descending currents to bring heat up from the depths of the solar mass and supply the superficial radiation during millions of years, and to allow of the progressive contraction of the greater portion of the mass repairing, in calories, a part of the secular loss. M. Faye considers that the circulation of solar hydrogen arises from a more general phenomenon than that supposed by M. Zöllner, viz., the vortical movements (with vertical axes) produced in the photosphere by its own special mode of rotation; and then radiation is connected with a still more general phenomenon, the mode of alimentation of the photosphere.

Thoracic and Abdominal Phosphorescent Organs of Cocuyo de Cuba (*Pyrophorus noctilucus*, *Elater noctilucus* L.).—MM. Robin and Laboulene.—The authors state that the light first appears in the centre, then spreads throughout. A yellow linear zone of adipose tissue at the exterior, at length becoming luminous, is yet not photogenic; it only reflects the light produced by the central part. But it does so, not only from its internal face but throughout its thickness, the action being favoured by the transparency and high refringent power of the fatty globules. The phenomena of dispersion and interference thus produced are the cause of the remarkable brilliancy appearing when the light from the centre reaches as far as this zone. As to the changes of molecular state in the tissue proper of the organ, the authors think the phosphorescent tissue produces a substance which slowly accumulates in the cells independently of all nervous influence, and of the same order with other secretions; and that only the act by which it is discharged is voluntary. The principle rendering the cells luminous behaved like the *noctilucine* extracted by Phipson. The abundance of urates in the cells makes it probable that uric acid results from the photospheric decomposition of the preceding coagulable compound. The large number of tracheæ in the apparatus is doubtless connected with the consumption of oxygen accompanying the phenomena.

Direct Demonstration of the Fundamental Principles of Thermo-Dynamics.—Continued extract from memoir by M. Ledieu.—This gives a direct demonstration of the amplified principle of Carnot.

Rapidity of Production of Phylloxera.—M. Lichtenstein.—The author considers that nine generations often appear in the three summer months. (A letter from M. Dumas describes the good effects of sulphide of carbon as a remedy against the insect.)

Spectrum of the Comet III. of 1873.—MM. Wolf and Rayet.—It consists of a continuous spectrum from the yellow to the violet, due partly to reflected solar light, and of two luminous bands, one in the green the other in the

blue, both diffuse towards violet. It is thought the comet may have a solid nucleus.

Spectrum of the Solar Atmosphere.—M. Rayet.—In studying a large faculæ on the 16th August the author observed a peculiar mode of reversal of the line D. At a certain height *one only of the two lines*, the less refrangible, appeared luminous; and nearer the edge, when both lines were reversed, the less refrangible was always brighter than the other. The eruption at this point retained this character some time, for on the 24th the singular reversal was again observed. The author thinks it a general law that in a group of neighbouring lines of a substance it is the less refrangible that is most readily reversed.

Influence of Changes in Barometric Pressure on the Phenomena of Life.—Twelfth note by M. Bert.—When oxygen accumulates to about 30 per cent in the arterial blood (of a dog) it produces convulsions; and the fall of temperature which occurs indicates a profound change in internal nutrition. It is not that the blood becomes a poisonous substance through superoxidation, but that the excess of oxygen in the tissues themselves alters the chemical phenomena of nutrition. Similarly compressed oxygen hinders the germination of seeds, the putrefaction of fragments of muscle, the change of starch into sugar by saliva, the development of *Mycoderma aceti*, and a number of like phenomena.

Of Hay Asthma, or Hay Fever, as a Morbid Entity.—M. Decaisne.—He thinks the emanations from forage plants only play a very secondary part in the disorder, which attacks people whether exposed to these or not. It occurs in any season, and annual periodicity is not proved. It is "a catarrhal fever, influenced and modified in its various causes, in its progress, and, according to individual aptitude, by atmospheric conditions which produce acute affections of the bronchi."

On a Principle of Union of Universal Chemistry applicable to Organic Chemistry.—M. E. Martin.—The chemistry which we call universal comprehends the two electricities as material simple bodies, and establishes their properties, physical and chemical. It is founded, moreover, on the knowledge of the true ponderable elements, those which are at present recognised as such being mixed compounds; that is to say, being formed by a primary union, in definite proportions, of the true elements with the two simple imponderable bodies. According to universal chemistry, the elements, ponderable and imponderable, are divided into two classes according to their affinities. Those which possess the affinity of oxygen form the oxyc class, comprising oxygen—which is *not* oxygen gas,—fluor, chlorine, bromine, iodine, and nitrogen, and by the simple imponderable body *electrile* (symbol, El), which is the so-called negative electricity. The basic class is formed by the elementary bodies, hydrogen—of which hydrogen gas is a compound,—carbon, sulphur, phosphorus, selenium, arsenic, boron, silicon, all the metals, and the imponderable body *etherile* (Et), known as positive electricity. Bodies of the same class cannot unite directly with each other. There are four modes of chemical union, one of which only has been known hitherto:—1. Union of the two simple imponderable bodies among themselves, which yields as product light and heat. 2. Union of simple ponderable bodies of the basic class to the simple imponderable body of the oxyc class, which gives combustible compounds, such as hydrogen gas, &c., and that of the simple ponderables of the oxyc class to the imponderable of the basic, which yields oxygen and chlorine gases, &c. 3. Union of the compound bodies among themselves, which may take place in two distinct manners, without alteration in the constitution of the bodies which unite. In this manner unstable compounds are formed, as takes place in organic bodies. 4. Union between combustible and burning (*comburants*) bodies with double decomposition. The last-mentioned mode, in its two forms, the dry and the humid, is the only one hitherto known. (The substance of this memoir was put forward by the author several years ago in a work entitled "Nouvelle Ecole Electro-Chimique").

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxii., No. 1, September 4, 1873.

This number contains no original chemical matter.

No. 2, September 11, 1873.

Horsky's Diffusion Apparatus.—This apparatus does away with the rasping process in the manufacture of beet-root sugar, dispenses with three-fourths of the manual labour, and extracts the saccharine matter completely. The yield of sugar obtained by the use of this arrangement has this season amounted to 8·5 per cent, an amount greatly superior to that obtained in neighbouring establishments where other processes for extraction are in use.

Dr. Jeannel's Horticultural Manure.—

Nitrate of ammonia	400 parts.
Biphosphate of ammonia ..	300 ,,
Nitrate of potash	250 ,,
Hydrochlorate of ammonia	50 ,,
Sulphate of lime	60 ,,
Sulphate of iron	40 ,,

Eudiometric Pipette.—M. Jean.—A modification of Regnault's apparatus, which would not be intelligible without the accompanying illustration.

Gases of Petroleum and of Resin.—M. Benavites.—A comparison of the illuminating power of these gases with common coal-gas.

Solidification of Nitrous Oxide.—M. T. Will.—The solidification of this body is readily obtained by passing a rapid current of air across the liquefied gas. Unlike liquefied carbonic acid the protoxide of nitrogen can be kept for a long time in a liquid state in open vessels. The protoxide of nitrogen when liquefied boils at $-92°$, and solidifies at $-99°$, so that the tension of its vapour is less than 1 atmosphere. The specific gravity of the liquid protoxide at 0° is 0·9004; its coefficient of dilatation is considerable, and it is insoluble in water.

New Series of Aromatic Hydrocarbides.—Th. Zincke.—By the reaction of powdered zinc upon a mixture of benzol and chloride of benzyl the author obtains, besides diphenzyl-methan, two isomeric dibenzyl-benzines, $C_{20}H_{18}$.

New Method of Preparing Caustic Soda.—M. Helbig.—The crude lye is evaporated in cast-iron boilers. At a certain heat the cyanides contained in the pasty mass are decomposed with escape of ammonia, and deposition of carbon. When this point is reached the heat is raised to redness, and the mass becomes more fluid. A sheet-iron cover is then fitted upon the boiler, provided with an opening through which enters an iron pipe. This is plunged into the mass and air is forced in. The graphite which separates rises to the surface and may be collected. The mass is tested from time to time to see if the sulphur is perfectly oxidised. When this is the case the blast is stopped, the mass allowed to become clear, and run off as usual.

Examination of Grape Sugar and Milk Sugar.—M. Campani.—The author employs as reagent a concentrated solution of subnitrate of lead, mixed with a dilute solution of acetate of copper. The liquid to be tested is added to 5 c.c. of this solution and raised to a boil. If grape-sugar is present the mixture becomes coloured, and gives a yellow precipitate. Cane-sugar has no action. A dilute solution of milk-sugar behaves like grape-sugar. If the solutions of these sugars are concentrated the precipitates are brick-red.

Action of Soap Lyes on Incandescent Metals.—M. Barette.—The author finds that balls of red-hot metal are scarcely cooled by immersion in soap solutions. It appears as if the presence of soap in the water facilitated the asumption of the spheroidal state. Albumen, glycerin, and other organic matters have a similar action.

Bulletin de la Societe Francaise de Photographie, No. 8, 1873.

At a general meeting of the Society, August 1, 1873, a letter from M. Anthony, of New York, offering the following prizes, open to photographers of all nations:—100 dols. for the best bust of a lady; 100 dols. for the best head of a boy under six years of age; 100 dols. for the best head of a girl under six years of age; 100 dols. for the best group of two children under six years of age; 100 dols. for the best landscape. The proofs to be 16½ by 21½ centimetres, mounted on cards 25½ by 30½ centimetres.

M. Guilleminot presented to the Society a photographic trough made of hardened gutta-percha. This material resists elevated temperatures better than the ordinary gutta-percha.

M. Davanne gave an account of the photographic department of the Vienna Exhibition.

M. Champion gave the following as the result of his experiments on the preparation of gun-cotton:—The acid mixture consists of 2 measures of nitric acid at 40° B. (?), obtained by mixing common and fuming nitric acids. 3 measures of sulphuric acid at 66°. The mixture may be used either cold or at 40° C. The cotton is left in contact with the acid for three minutes, and the product washed till perfectly neutral.

M. H. Pellet gave an experimental demonstration of the process of M. J. Chrselshom for freezing silver baths from an excess of iodide of silver. He takes a common solution of nitrate of silver, to which are added a few c.c. of a solution of iodine in water slightly alcoholised. The liquid becomes yellow and turbid without precipitation. 2 or 3 drops of pure hydrochloric acid are then added. A precipitate of chloride of silver falls. The liquid is stirred, and on standing the supernatant solution contains the greatest part of the iodine added. The chloride of silver recently precipitated is decomposed by the iodine. Iodide of silver is formed and thrown down along with the excess of chloride of silver.

Sensibility of Different Layers of Collodion.—M. Redon.—The author finds that opaque films of collodion receive an impression rapidly, and show an intense colouration, whilst transparent glassy films are impressed more slowly snd feebly, and sometimes not at all.

Polychromic Photography.—Leon Vidal.—A repetition and expansion of the process briefly described in the last number, with an account of certain specimens of photographs in colours.

Revue Scientifique de la France et de l'Etranger, September 6, 1873.

This number is taken up with an account of the Lyon meeting of the French Association for the Advancement of the Sciences. At one of the "Public Conferences" M. A. Gaudry delivered a lecture on the modern progress of chemical industry. He informed his audience that the amount of sulphuric acid manufactured annually in Europe amounts to 800,000,000 kilos. and would fill a canal 2 metres deep, 10 wide, and 25 to 30 kilometres in length. To yield this acid 800,000 tons of pyrites are yearly consumed. The condensation of the hydrochloric acid liberated in alkali works; the improvements of Mr. Weldon and Mr. Deacon in the manufacture of chlorine; the revolving soda-furnace; the extraction of potash as a secondary product in the manufacture of beet-root sugar: and the recent improvements in producing paper-pulp from wood, are among the principal points touched on in the remainder of this popular and able lecture.

Revue Hebdomadaire de Chimie Scientifique et Industrielle par Ch. Mène, June 12, 1873.

This number contains no chemical matter.

Reimann's Färber Zeitung, No. 29, 1873.

This number contains a notice of the tinctorial department of the Vienna Exhibition.

There are receipts for dyeing a dark grey on wool; a silver grey, an olive, and a bright olive on the same material.

For a scarlet on wool, woollen yarn, and woollen cloth, capable of bearing the milling process, the author gives the following formula:—To 10 lbs. of material take 1½ lbs. of oxalic acid, 7½ ozs. tin crystals, 3 ozs. flavin, and 1½ lb. cochineal.

There are also receipts for a lac scarlet, and a grain orange on wool; a catechu black on silk; a finish for cottons; a logwood blue for cotton-wool; a yellow on the same fibre; and an anilin green on cotton, which we quote,—For 10 lbs., allow the goods to soak three hours in a hot solution of ½lb. tannin. The cotton thus mordanted is dyed in a recent cold solution of either iodine or methyl green acidulated with acetic acid; picric acid being added if a yellower tone is required.

There are also directions for a cheap logwood blue on cottons, and a reseda on old white silks produced by means of quercitron after mordanting with nitrate of iron.

There is a notice of Lamy's patent for brown on cotton by printing upon the goods nitrate, acetate, or hydrochlorate of naphthylamin with chlorate of potash, a salt of copper, or hydrofluosilicic acid. The calico is then exposed to the air, and passed first through an acidulated bath of chromate of potash, and finally through an alkaline solution. The brown is equal in permanence to an anilin black.

Dufréné proposes to pass tissues which are liable to be exposed to wet through a dilute solution of tannin, and then through chromate of potash till they turn brown, when they are washed and dried.

For an antichlore, sulphite of soda is recommended as preferable to the hyposulphite, which generally leaves a yellowish deposit of sulphur in the fibre.

In Lauth's process for fixing anilin green on wool by working in a bath of hyposulphite acidified with hydrochloric acid, an addition of alum is recommended to restore the elasticity of the wool, and free it from a smeary handle. The following two receipts for soap are given by a manufacturer of silicate of soda. For a toilet soap take 150 lbs. cocoa-nut oil; 50 lbs. lye at 40 per cent; 50 lbs. silicate of soda; and 5 lbs. of glycerin. For a fuller's soap take of fat 100 lbs.; potash lye at 30 per cent, 10 lbs.; potato starch, 10 lbs. in 20 lbs. of water; and 10 to 12 lbs. of silicate of soda at 30 per cent. Here there are 88 lbs. of adulterants to 100 lbs. of fat. Such soaps cannot be distinguished from genuine kinds by mere inspection. In order to dye an anilin black on yarn it is recommended to precipitate peroxide of manganese on the fibre, and then treat with anilin black.

No. 30, 1873.

This number contains receipts for a reddish drab grey on wool and woollen yarns; for a darker shade on the same materials; a reddish mode drab; a red-brown on wool and yarns; a blackish violet, a dark dahlia, a mulberry and an olive-brown on woollen piece-goods; a bright green capable of bearing milling on woollen yarn; for printing a fast steam black on wool; for a bright and fast green on cotton; a fine and cheap reddish brown on woollen yarn; for dyeing stiffened cotton yarns; and for black on linen yarn.

Rave proposes to treat dye-woods with soda or lime, and precipitates the solution with hydrochloric acid. The precipitated colour is sold as paste or powder.

Leather can be tanned in six days with a mixture of 10 parts tobacco root, 60 parts catechu, and 30 parts sumac.

The following receipt has been patented for scarlets on cotton:—2 lbs. solution of lac, 1½ lbs. of gum, 1 lb. tin crystals, 1 lb. oxalic acid, 8 quarts of water, and 1 quart decoction of oak-bark.

No. 31, 1873.

This number contains a list of the manufacturers of tinctorial chemicals to whom prizes have been awarded at

the Vienna Exhibition. We find no English name in the catalogue.

There are receipts for dyeing wool a bright green; for a finish for pack-thread; for a reseda on genappe; a brown on silk; a printing black on cotton yarn; a blue-black on old cotton, velvets, and velveteens; a chamois and rose on old goods with cotton warps, saffranin on a sumach mordant being recommended for the latter; a black on mixed woollen and silk; a dark green on wool; a cheap violet on woollen piece-goods. For this the author recommends per 100 lbs. of cloth to boil for an hour-and-a-half with 2¾ lbs. chromate of potash, 1¼ lbs. blue vitriol, ¾ lb. oxalic acid, and ¾ lb. sulphuric acid. The cloth is either allowed to cool in the decoction, or rinsed at once, and dyed in a fresh bath with 40 lbs. of logwood, 10 lbs. camwood, and 2½ lbs. of orchil, boiling for one hour. There are also receipts for a chestnut and a scarlet on wool, and for printing a black on flamed woollens. The editor extracts from a contemporary the following formula for a yellow:—"To an armful of woollen yarn take three table-spoonfuls of tin crystals, a saucer-full of flavin, and a milkpot full of oxalic acid. The whole is allowed to boil up, and so much water added that the operator can bear his *tongue* in the bath. The yarn is then entered, the heat raised to a boil, and the goods worked while the Lord's Prayer can be repeated twenty times!" Dr. Reimann, very pardonably, adds a sarcastic comment on such a gem of technological literature.

For bleaching wool the bisulphite of soda is proposed dissolved in water, and mixed with two-fifths its weight of hydrochloric acid.

Mahogany and rosewood yield a colouring matter resembling catechu. The rasped woods are roasted like starch, then extracted with water, and the liquid evaporated to the consistence of a syrup, or to dryness.

MISCELLANEOUS.

British Association for the Advancement of Science.—The following is a list of the papers read before Section B (Chemical Science) at the Bradford meeting:—

The President's Address.

Report on the Chemical Constitution and Optical Properties of Essential Oils.

J. H. Gladstone, F.R.S.—On Black Deposits on Metals.

A. Tribe, F.C.S.—On a Specific Gravity Bottle for Inflammable Liquids.

W. H. Pike.—On the Homologues of Oxaluric Acid.

C. R. A. Wright, D.Sc., F.C.S.—On Derivatives of Codeine and Morphine.

Professor Williamson, F.R.S.—Report of the Committee for Superintending the Monthly Reports of the Progress of Chemistry.

Professor G. C. Foster, F.R.S.—Report on Siemens's Pyrometer.

W. Chandler Roberts, F.C.S.—Report on the Method of Making Gold Assays, and of Stating the Results thereof.

J. Dewar, F.R.S.E.—Report on High Temperatures.

A. Vernon Harcourt, F.R.S., and F. W. Fison, F.C.S.—On a Continuous Process for Purifying Coal-Gas, and Obtaining Sulphur and Ammonium Sulphate.

C. J. Woodward, B.Sc.—A New Form of Gas Generator.

J. Spiller, F.C.S.—An Artificial Magnetite.

Dr. Paul and A. D. Cownley, F.C.S.—On the Valuation of Commercial Crude Anthracen.

J. Norman Lockyer, F.R.S.—Note on the Elements in the Sun.

R. B. Grantham, C.E.—Report of the Committee on Sewage.

W. T. McGowen.—On the Sewage of Manufacturing Towns.

W. Chandler Roberts, F.C.S.—On Horn Silver.

Dr. A. Schafarik.—On the Constitution of some Silicates.

Professor Crum-Brown, F.R.S.E.—On the Action of Sulphide of Methyl on Bromacetic Acid.

Charles Horner.—On the Spectra of certain Boric and Phosphoric Acid Blowpipe Beads.

Alfred H. Allen, F.C.S.—On the Detection of the Adulteration of Tea.

Alfred H. Allen, F.C.S.—On the Action of Sulphuric Acid on Ethylanilin and Dimethylanilin.

Alfred H. Allen, F.C.S.—Note on Cresol Derivatives.

Dr. H. E. Armstrong.—On Alpha- and Beta-Naphthylic Sulphide.

Place of Meeting for Next Year.—The meeting next year will be held at Belfast, commencing on August 19. President Elect—Professor Tyndall, D.C.L., F.R.S., &c.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the utilisation of the waste heat from coke ovens for the manufacture of soda ash, caustic soda, and for other similar purposes. Hugh Williams, Wigan, Lancashire. January 23, 1873.—No. 268. My invention consists principally in arranging two or more coke ovens side by side, in such a manner that their flues unite in one chamber, and charging and working such coke ovens alternately or in succession, and in employing the heat and gases evolved therefrom in a secondary furnace adjoining the said coke ovens for the manufacture of soda ash, caustic soda, and other similar manufacturing purposes.

Improvements in the purification of coal-gas, and in the production of alkaline sulphides to be employed for such purpose. Robert Hogarth Patterson, Hammersmith, Middlesex. January 23, 1873.—No. 274. This invention relates, firstly, to the production of alkaline sulphides (to be subsequently employed in the purification of coal-gas, either in the manner described in my Patent, dated March 9, 1872, No. 730, or otherwise), by decarbonating impure coal-gas—that is, gas containing carbonic acid and sulphuretted hydrogen—in alkaline washers or scrubbers or in lime-purifiers in such manner that, while the carbonic acid is arrested in the said washers, scrubbers, or purifiers, sulphuretted hydrogen is driven forward, and converts alkaline substances, such as potash or ammonia, ammoniacal liquor, or gas liquor, contained in subsequent vessels, into sulphides. I also employ the said process for the purpose of more highly sulphuretting gas liquor, whether decarbonated or not, so as to render the said liquor an efficient material for purifying coal-gas from sulphur contained therein in other forms than that of sulphuretted hydrogen. This invention relates, secondly, to a system of purification whereby the elimination of carbonic acid from coal-gas is effected by means of lime and alkalies before the said gas is passed through vessels containing alkaline sulphides, either in a solid or in a fluid form, with a view to purify the gas from sulphur contained therein in other forms than sulphuretted hydrogen.

Improvements of soup-farina. Edward Heinson Huch, merchant, Brunswick, Germany. January 24, 1873.—No. 288. This provisional specification describes dissolving extract of meat in salt water, and adding flour of various kinds.

An improved mode of or process for obtaining fertilising substances. Major-General Henry Young Darracott Scott, C.B., Ealing, Middlesex. January 25, 1873.—No. 296. The object of this invention is the manufacture of precipitated phosphates by the addition to clarified sewage water of impure phosphatic substances, such as coprolites, dissolved in acid.

Improvements in the torrefaction of animal substances for the purpose of manufacturing manure therefrom, and in the apparatus or means employed therein. John Henry Johnson, 47, Lincoln's Inn Fields, Middlesex. (A communication from the firm of Coignet, Son, and Co., Paris). January 25, 1873.—No. 305. This invention consists in torrefying animal solid and liquid substances by the direct contact therewith in closed chambers of gases superheated to a temperature of about 550° F. Also in first drying the substances by the direct contact of gases heated to about 330° F., and then torrefying as above described. Also in cooling the torrefying mass by the application thereto of jets of water or saline solutions.

A new and improved artificial stone or cement to be used in aquatic or other buildings, also moulded and made applicable to ornamental, architectural, and other purposes. Henry Adrien Bonneville, patent agent, 6, Piccadilly, Middlesex. (A communication from Messrs. Schenck, Baronet, and Hayek, acting as administrators of the company known as Weiss Cement Actien Gesellschaft, two persons resident at Vienna, Austria). January 27, 1873.—No. 310. This invention relates to the manufacturing of a water mortar, and consists in using the dolomites or magnesian stones or the minerals which contain at least 25 per cent of MgC_2O_3 or the productions of chemical fabrication, which are combinations of magnesia, and which can be reduced by heat.

Improved processes and furnace with appliances for the economical production of baryta. Thomas James Smith, of the firm of Robertson, Brooman, and Co., patent agents, 166, Fleet Street, London. (A communication from Cyprien Marie Tessié du Motay, chemist, Paris). January 28, 1873.—No. 328. This refers to an arrangement of furnace with the employment of solid or gaseous combustibles for the transformation by the dry method of sulphate of baryta into sulphuret of barium and of carbonate of baryta into baryta.

THE CHEMICAL NEWS.

VOL. XXVIII. No. 723.

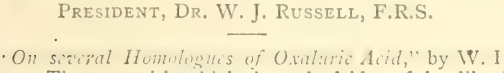
BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

BRADFORD MEETING, 1873.

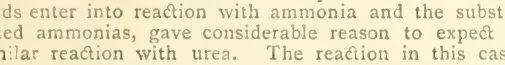
SECTION B.—CHEMICAL SCIENCE.

PRESIDENT, DR. W. J. RUSSELL, F.R.S.

"*On several Homologues of Oxaluric Acid*," by W. H. PIKE.—The ease with which the anhydrides of the dibasic acids enter into reaction with ammonia and the substituted ammonias, gave considerable reason to expect a similar reaction with urea. The reaction in this case might be expected to take place in one of two ways: either a body homologous with barbituric acid would be formed, as expressed in the equation—



or a simple addition might take place, the body formed being a homologue of oxaluric acid, thus:—



As far as my experiments extend, the second equation expresses the reaction which takes place.

Succinic Anhydride with Urea.—Urea, heated with succinic anhydride in the proportion of their molecular weights to 120° to 130° C., dissolves in the fused anhydride to a thick oily liquid, which in a short time becomes solid with considerable reaction. The raw product thus obtained is powdered, and, after washing with cold alcohol to remove unaltered anhydride, re-crystallised from water. The analysis gave numbers which agree with those calculated for the formula, $C_5H_8N_2O_4$. The acid crystallises from water in small brilliant scales, which, when rapidly heated, fuse under complete decomposition at 203° to 204° C. It is nearly insoluble in cold water and alcohol; perfectly so in ether, chloroform, and bisulphide of carbon; moderately soluble in boiling water and glacial acetic acid. In concentrated sulphuric acid it is at once dissolved, and is precipitated entirely unaltered on dilution. It forms easily soluble salts with the alkalies and alkaline earth. The silver and lead salts are white crystalline precipitates, which are nearly insoluble in boiling water. The silver salt gave numbers on analysis which correspond with those calculated for the formula $C_5H_7AgN_2O_4$. The constitution of this acid will probably be—

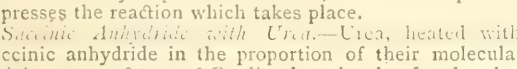
$$\begin{array}{l} CH_2—CO—NH—CO—NH_2 \\ | \\ CH_2—COOH\,; \end{array}$$

I have therefore named it succino-carbaminic acid.

Succinic Anhydride with Sulpho-Carbamid.—Succinic anhydride enters into combination with sulpho-carbamid with the same ease as with urea. Owing to the higher fusing-point of the sulpho-carbamid, the heat must be raised somewhat higher (about 150° C.) before the mixture is completely fused; it then soon becomes solid, as in the previous case. The raw product is washed with alcohol and crystallised from water. It forms a slightly yellow-coloured crystalline powder, which possesses similar properties to those of the preceding compound. It fuses at 210·5° to 211° C. It is somewhat less soluble in boiling water and acetic acid; in cold water, alcohol, and ether, absolutely insoluble. Sulphuric acid also dissolves it, without alteration, in considerable quantity. It forms with the alkalies easily soluble salts, and with lead and silver white precipitates, which blacken if heated. The analysis gave numbers which agree with those calculated for the formula $C_5H_8N_2O_3S$. This compound will thus be succino-sulpho-carbaminic acid—

$$\begin{array}{l} CH_2—CO—NH—CS—NH_2 \\ | \\ CH_2—COOH. \end{array}$$

Citraconic Anhydride with Urea.—I have not as yet succeeded in obtaining any combination between citraconic anhydride and urea when these two bodies are heated to 115° C. Carbonic acid is given off, and citraconamid is formed, most probably as expressed by the following equation:—



Citraconic Anhydride with Sulpho-Carbamid.—Citraconic anhydride, however, combines at once with sulpho-carbamid to form a body which may be named citracon-sulpho-carbaminic acid. It may be purified in the same way as the preceding compounds, which in all its properties it closely resembles. It fuses at 222° to 223° C. under complete decomposition; it also gives easily soluble salts with the alkalies, and with nitrate of silver and of lead insoluble white precipitates which blacken on heating. The numbers obtained on analysis show that this acid possesses the formula $C_6H_8N_2O_3S$, the probable constitution being—

$$\begin{array}{l} C_3H_4 \begin{array}{l} CO—NH—CS—NH_2 \\ COOH. \end{array} \end{array}$$

Lactid with Urea and with Sulpho-carbamid.—Neither with urea nor with sulpho-carbamid could I obtain from lactid any combination analogous to the preceding. Lactid, when heated with urea, gave off carbonic acid and formed a substance the examination of which is not complete; with sulpho-carbamid the same body was formed, with separation of oxysulphide of carbon.

I also heated succinic anhydride with sulpho-carbanilide, but this body decomposes, under the influence of the anhydride, into phenyl-mustard oil and anilin, which then acts on the anhydride.

I propose to continue the study of the action of the anhydrides of other dibasic acids on urea and on sulpho-carbamid.

"*Report of the Committee on Siemens's Pyrometer.*"—The following is the substance of the report presented to Section B, by Professor G. C. FOSTER, F.R.S.:—Siemens's Pyrometer is an instrument for the measurement of high temperatures depending upon the change produced by heat in the resistance opposed by platinum to the passage of an electric current. It consists essentially of a coil of platinum wire, suitably protected, and so arranged that its resistance can be measured while it is exposed to the temperature it is desired to ascertain. The importance of possessing some trustworthy method of measuring temperatures beyond the range of the air-thermometer induced the British Association to appoint a committee to examine and report upon the merits of this instrument.

The first step was evidently to test the electrical permanence of the pyrometer, and the attention of the committee has as yet been confined to the examination of this point. At the Brighton Meeting in 1872, it was reported by them that a pyrometer whose resistance was, to begin with, 9·917 B. A. units at 10° C., had a resistance of 10·502 at the same temperature, after having been repeatedly heated to redness. This change was found by Professor Williamson to be, in all probability, due to chemical alteration of the platinum caused by the combined action of the silica of the porcelain core on which the wire was coiled and of the reducing atmosphere existing inside the protecting wrought-iron tube. The committee have, since then, been supplied by Mr.

Siemens with two new pyrometers, in which, with the hope of preventing the alteration previously found, a platinum tube has been introduced, surrounding the coil and separating it from the outer iron case. This addition, however, does not seem to have caused any considerable improvement, the resistance of one of the pyrometers having been at first 9·920 at 10°, and, after being twice heated to redness, 10·462 at the same temperature; the other had, to begin with, the resistance 9·988 at 10°, and after one heating its resistance was 10·465 at the same temperature. It is, however, quite possible that little or no further change would be found to occur after the first few heatings, but the committee have been unable during the past year to make sufficiently numerous experiments to enable them to form an opinion on this point. They therefore ask to be re-appointed, and for a renewal of the unexpended grant of £30, which was originally placed at their disposal.

"*Report on the Method of Making Gold Assays, and of stating the results thereof*," by W. CHANDLER ROBERTS, F.C.S.—The attention of the Committee was first directed to a series of experiments which were instituted with a view to ascertain to what extent the weight of pieces of pure gold and of alloys, synthetically prepared, would be affected by submitting them to the process of assaying, and consequently how far the results of assay operations are trustworthy. These results showed that the maximum error was only 1-100th per cent of the original weight of the assay piece, and consequently that the result obtained by assaying gold represents the composition of the portion of metal under examination to the 1-10,000th part, a fact which will doubtless appear remarkable to all who are accustomed to the ordinary methods of quantitative analysis.

The committee are not unmindful that, although it is possible to attain this high degree of accuracy, it is nevertheless well known that a comparison of the assay reports of the different assayers as to the composition of the same ingot might often disclose discrepancies of 5-10,000th parts.

Thus portions of metal from nineteen gold ingots were assayed by the Mint Assayer and were then sent to five assayers, each of whom furnished an independent report. Two assayers alone agreed as to the value in each of 15 ingots, in 3 ingots three assayers were in accordance, while in one instance all the assay reports differed; and, viewing the reports generally, the discrepancies varied from 4-10,000 parts to 1 part of fine gold in 1000 of the alloy, or an average deviation of 6-10,000th parts.

These small variations assume serious proportions when they affect the value of large quantities of bullion; for instance, the value of gold coined in the Mint during the past year was £15,200,000, and a persistent error in the assay reports of only 1-10,000th part would have been attended with a gain or loss to the department of no less than £1500. The Committee have entered upon the following investigations, in the hope of being able to define the condition under which errors arise:—

The method of gold assaying, as practised in the Mint, is given in the Appendix, and the method has been deliberately adopted by all assayers with slight variations of manipulation, which have not as yet been minutely examined, as the Committee considered that when widely divergent results are obtained, the gold employed by one or other of the assayers is impure, and that either the amount of impurity has not been ascertained with accuracy, or that it altogether escapes detection. It follows, therefore, that the weight of the "cornets," when compared with the initial weight, the portion of metal operated upon appears to indicate the presence of an amount of gold which is in excess of the true amount of precious metal present in the alloy.

The Committee obtained specimens of gold from different sources, and tested them side by side with gold prepared in accordance with the directions of the Lords Commissioners of Her Majesty's Treasury, by the Chemist of the Mint for use as a standard trial plate in testing the coinage. Great care was taken in the preparation of this gold, 80 ounces of which were precipitated from no less than 100 gallons of chloride of gold, and experiments have already shown that it is very pure. The Committee propose that they adopt it as the basis for a new series of comparisons.

"*High Temperatures*."—Mr. J. DEWAR, F.R.S.E., stated the substance of a report on high temperatures. It had been thought that, as a low red heat brought out only the red end of the spectrum, and the spectrum gradually extended towards the violet end as the temperature rose, this fact might be used as a means of measuring temperatures. The difficulty, however, in employing this method was that for a great portion of its length the growth of the spectrum was very rapid. There also appeared at the beginning of the spectrum a grey light, which prevented the red ray from being seen. Then the human eye was much more sensitive to some parts of the spectrum than to others. This difference between the length of the spectrum and the range of human vision would cause a mis-estimation of temperature unless the spectrum could be registered by some photographic process. He (the speaker) had, therefore, thought it better to reconsider the object of the grant made by the Association, and report rather upon the increase in the quantity of light than in the length of the spectrum. The relation between the intensity of the light evolved and the heat indicated had been already well established, though their relative rate of increase had not been ascertained. Becquerel concluded that the intensity of the light was, in mathematical language, a function of the heat, growing with very great rapidity in proportion to the latter. He came to this conclusion because the radiation of heat increases with the temperature by the same law. The experiments made by himself had led him to the conclusion that at temperatures of upwards of 1000 degrees the function was a parabolic, that is, that the temperature increases as the square of the light. He said above 1000 degrees, because that temperature was required to eliminate the effects arising from the growth in the length of the spectrum. This parabolic function gave a much slower increase of light than was estimated by Becquerel. Experiments on radiant heat had also been conducted by him (the speaker) with a view to measuring high temperatures by a method similar to that which we employed to measure the radiation of the sun itself. A portion of the surface of the heated body whose temperature was to be ascertained was caused to radiate its heat on the blackened surface of a cube containing water, and from the number of degrees which the temperature of the water rose in a fixed time, the heat of the radiant body was concluded Whilst on this line of experiment it was found that MM. Dulong and Petit's law did not hold good above a low red heat, the explanation probably being that the violet light waves did not carry so much energy as the larger red ones.—Mr. DEWAR, who had at considerable length and with much facility of illustration, explained the results of the report instead of reading it, concluded amidst some applause.

Dr. GLADSTONE said the chief difficulty that had occurred to him with regard to the measurement of high temperatures by the spectrum was that it would be far from easy to determine where one colour ended and another began, and this very difficulty had proved insuperable. Even the same spectrum was different in appearance to different eyes. When he was experimenting in association with the late Sir D. Brewster he noticed that the latter could see rays of much lower refrangibility than he (the speaker) could, whilst he could see a greater portion of the violet end of the spectrum than could Sir David Brewster. However, by the several methods which had that day been explained—including the Siemens pyrometer—they were placed in a position to make comparison of one with another, and thus obtain a reliable result.—A few further remarks were made (it being observed that although they had several means of comparing

high temperatures relatively to each other, there were as yet no means of ascertainlng the absolute temperature registered by pyrometers), and the President closed the discussion by a hope that the committee would continue its investigations next year.

"*On a Continuous Process for Purifying Coal Gas from Sulphuretted Hydrogen and Ammonia, and for Extracting Sulphur and Ammoniacal Salts*," by A. VERNON HARCOURT, F.R.S., and F. W. FISON, F.C.S.—The introduction of "oxide" for purifying "foul gas" has furnished the gas-maker with a process which might fairly be described as continuous when compared with the use of lime. But after the oxide has been alternately sulphurised and revivified twenty or thirty times, it is rendered inert by the accumulation of sulphur, and fresh oxide has to be substituted for it. The spent material, consisting of a mixture of oxide and sulphur in about equal bulks, is either burnt like pyrites on the hearth of the vitriol-maker, or it is heated until the sulphur is separated by sublimation. In either case the oxide itself is rendered anhydrous by the action of heat, and cannot be used again for gas purification.

Ammonia is most commonly removed from gas by "scrubbing," and the construction of scrubbers and the mode of working them has been brought to great perfection. Nevertheless this process is liable to some objections. The scrubbers are bulky erections, and the cleansing of them, which is generally found to be necessary from time to time, is a troublesome operation. Also, the ammonia is not obtained in the most portable and saleable form, as a solid salt, but as a solution containing perhaps 20 ozs. of ammonia in a gallon of water. Although the volume of water used in scrubbing gas is relatively very small, it cannot fail to produce some reduction of illuminating power, since olefiant gas is far from insoluble, and a more copious washing reduces the illuminating power in a very noticeable degree. The use of copperas, or of sulphuric acid and sawdust, or of other substances that may be employed in a similar manner, is commonly designed to supplement the use of scrubbers, and requires the appropriation of a distinct set of purifiers, or at any rate, the material used to stop ammonia must be kept separate from that which is used to stop sulphuretted hydrogen.

The extraction of sulphur from the spent oxide, and the manufacture of ammoniacal salts from the liquor, are operations which the gas manufacturer generally makes over as too troublesome for him to undertake to the manufacturing chemist. The process about to be described is one which we believe it will be both advantageous and easy for the gas manufacturer to conduct upon his works. It effects the removal of sulphuretted hydrogen and of ammonia simultaneously, and yields sulphur and sulphate of ammonia in a nearly pure state. It renders the erection of scrubbers, and pumping, and the washing of gas with water unnecessary. It restores the oxide, from which sulphur and sulphate of ammonia have been extracted, to the purifiers in the form of pure hydrated oxide, so that the same oxide may be used for an indefinite time. The new process is at once applicable wherever oxide is, or can be, used as the agent of purification, the only differences in the mode of working being that the oxide, during revivification, is moistened with a solution of ferric sulphate (persulphate of iron), and that a portion of the oxide is removed from time to time, and treated in the following manner:—It is first extracted with water, by the use of an arrangement similar to that employed in the extraction of black-ash. The soluble salts are sulphate of ammonia, formed in the purifiers by the reaction of ammonia and ferric sulphate, and, in smaller quantities, sulphocyanide, hyposulphite, and, probably, other salts of ammonia. This extract is mixed with a small excess of sulphuric acid, and yields, when concentrated by evaporation, crystals of sulphate of ammonia. The remainder of the substance is then boiled with dilute sulphuric acid, which dissolves the oxide, and leaves a residue of sulphur. The actual process of extraction by acid consists in treating the substance successively, (1) with a solution of ferric sulphate, containing some free sulphuric acid; (2), with a more dilute solution of ferric sulphate to which sulphuric acid has been added; (3 and 4), with more dilute solutions of ferric sulphate, all these liquids being the produce of a former extraction; and (5), with water. The liquid resulting from the first of the treatments enumerated above is a strong solution of ferric sulphate, which is used, as already mentioned, by being mixed with the charge of oxide before it is replaced in the purifier. The residue, after the final washing, consists almost entirely of sulphur, and requires only to be dried. It will be evident that all the oxide which has been freed from sulphate of ammonia and sulphur by this treatment passes into the condition of ferric sulphate, and, in this condition, is replaced in the purifier. There it again becomes oxide by the action upon it of the ammonia of the gas, which it completely removes, while the ammonia is fixed as sulphate.

In order to obtain by one operation all the ammonia found in the retorts, and to ensure the passage into the purifiers of a quantity of ammonia sufficient to neutralise all the acid employed in dissolving the oxide, we propose further to run the liquor from the condensers into a chest heated by steam, through the top of which a current of gas passes, which is drawn from beyond the exhauster, and re-enters the main leading to the condensers. By a suitable arrangement, the condensed liquor may run continuously through this chest, passing off after it has been heated in the current of purified gas.

"*On the Valuation of Commercial Crude Anthracen*," by Dr. PAUL and A. J. COWNLEY.—The authors proposed for the present unsatisfactory method of testing crude anthracen, that anthraquinon should be used as a basis of valuation. They had found that 178 parts of good anthracen were equivalent to 208 parts of anthraquinon. The melting-point for anthraquinon they had found to be 276°. The agent they recommended for oxidising the anthracen was a solution of chromic anhydride in glacial acetic acid. In reply to Drs. ARMSTRONG and MILLS, Dr. PAUL said it would take three days to make an estimation of anthracen, and that he could not vouch for the absolute purity of the anthracen he used as a standard.

Mr. J. NORMAN LOCKYER, F.R.S., read a paper "*On the Elements in the Sun*." He did not come before the section as a chemist, but as an amateur interested in certain inquiries which day by day seemed to be breaking out in a curious way in a chemical direction; and in prosecuting those inquiries he sought the assistance of the chemists. He believed that the more they knew about the sun and stars, the better it would be for astronomers and physicists and chemists as well. Mr. Lockyer then explained the processes by which, with the aid of the spectrum analysis, he was able to discover the composition of the sun. Mr. Huggins and Father Secchi had both paid great attention to the subject; and from the result of their observations and his own he had come to the following conclusions:—First, the absorption of some elementary and compound gases was limited to the most refrangible part of the spectrum when the gases were rare, creeped gradually into the visible violet part and finally to the red end of the spectrum as the pressure was increased. Second, the absorption of the photospheric light, and therefore the temperature of the photosphere of the sun was much greater than had been supposed. Third, the lines of compound metallic vapours lay generally in the red end of the spectrum, and this held good for absorption in the case of aqueous vapour. Such spectra, like those of the metalloids, were separated spectroscopically from those of the metallic elements by their columnar or banded structure. Fourth, there were, in all probability, no compounds ordinarily present in the sun's reversing layer. Fifth, when a metallic compound vapour was dissociated by the spark, the band spectrum died out, and the elemental lines came in according to the degree of tempera-

ture employed. Again, although their knowledge of the spectra of the stars was lamentably incomplete, he gathered the following facts from the work already accomplished with marvellous skill and industry by Secchi, of Rome:—First, the sun, so far as its spectrum went, might be arranged between stars with much simpler and with much more complex spectra. Second, Sirius, as a type of the former, was the brightest and therefore probably the hottest star in our northern sky; was only known to contain hydrogen, sodium, and magnesium; and the hydrogen lines in this star were enormously distended, showing that the chromosphere was largely composed of that element. There were many other bright stars of this class. Third, as types of the much more complex spectra, the red stars might be quoted, the spectra of which were composed of channelled spaces and bands. Hence these stars were of a lower temperature than our sun, and here the quantity of hydrogen was greatly reduced. He had asked himself whether these facts could not be grouped together in a working hypothesis, which assumed that in the sun and stars were various degrees of "celestial dissociation" at work, which prevented the coming together of the atoms which, at the temperature of the earth, and at all artificial temperatures yet attained here, formed the metals, all the metalloids not represented in each star, and the compounds known here at present.

In answer to Professor Janssen,

Mr. Lockyer said he thought it was extremely improbable that there should be any vapours which never came into the reversing layer; but of course, if this dissociation had any truth in it, there must be gold still in some part of the sun's atmosphere; but he asked whether it would not be at the extreme part of the corona rather than in the parts of the photosphere which were below the chromosphere. He had not said that gold was absent from the reversing layer of the sun, but that it had not been found there. The more the vapour occupied the lower part of the chromosphere the more conveniently would it give its spectrum; and recent researches had shown that the densities of substances which ordinarily occupied the lowest part of the reversing layer had little to do with the quantities there present.

Dr. Gladstone observed that a question of a very striking character had been raised; but it required thinking about for a little while before they could fairly grapple with it. It pointed to a revolution of their elementary idea in chemistry. He thought, however, that there was no impossibility whatever in what Mr. Lockyer had advanced. They knew that what they considered to be elements now were only elements to them. They did not know how to decompose them; but he imagined that there was no chemist whatever who imagined that they would never be able to decompose them. No chemist looked into the atomic weights and saw the curious relations between them without being convinced that there was some mystery behind them which would be revealed in the future. These were facts which were very suggestive indeed. If they greatly increased their power of heat and the other forces they could bring to bear on matter, they had greater power of tearing asunder those things which at the present time were elementary. The remark that there were no compounds in the reversing layer of the sun was very suggestive; and that would lead them to think that the dissociation had begun as far as our present metals, and that it was very possible that in Sirius and in some other stars it might go still further. He imagined, with M. Janssen, that there were various metals which were so very indisposed to rise into vapour that they would not come into that condition.

Professor B. Stewart thought Mr. Lockyer had acted very properly in throwing out the suggestion he had laid before the section. There had been too great a tendency in men of science to hoard up their ideas till they were almost certain in their own minds that their ideas were correct. He observed that he had found that iodine had a different spectrum for different temperatures; and he wanted to know whether this was due to mere molecular change in the iodine, or whether it was decomposed.

Dr. Huggins remarked that the chief character of the lines of Sirius was that they were much thinner and finer than in the other stars. The spectrum of Sirius was as full of fine lines as the solar spectrum. The subject was a vast one, and they must wait for further information upon it before they could speak decidedly upon those points to which Mr. Lockyer had so properly called attention. He wished success to all who were engaged in this field of inquiry.

Dr. Dewar dwelt upon the temperature of the sun and the electric light, and said that in order to settle this point they must take into consideration the total radiation of the sun. During the winter he had made experiments on the vapour densities of the alkaline metals, potassium and sodium. He found that in the case of the former the vapour density was normal; whilst in the case of sodium it was abnormal, being very much higher than it ought to be. This, he thought, accounted for the large amount of light and the enormous absorptive power of sodium vapour. The denser the vapour the greater was the amount of light got in the same temperature.

Dr. Siemens expressed the opinion that it was impossible to estimate the temperature of the sun by the amount of heat radiated from the sun; and said that Mr. Dewar, in making the comparison he had referred to, had compared two things which had utterly different conditions. In order to determine the temperature of the sun, they had only, as a safe guide, dissociation to go by. He thought Mr. Lockyer had opened out a new field of inquiry which might lead to important results.

Mr. Lockyer, in his reply, said he took it that they had undoubted proofs that there were stars with compounds in their atmospheres, and that there were stars with metalloids in their atmospheres, and that the temperature of those stars was not so high as that of the sun. What had been a great difficulty to him had been to discover evidence of magnesium and sodium before evidence with regard to the formation of other metals; but with respect to that point Mr. Huggins had corrected Father Secchi in a very important matter. With regard to the observations of the Egyptians, they had always been made when Sirius was just on the horizon, and the gases in our atmosphere then cut off all the blue light. Hence Sirius had been regarded as a red star.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 155).

To progress from simple to compound is a most satisfactory procedure. Adopting this plan, and dealing with only two of the thirteen elements—ignoring the others—placing the two in such a relation that their mutual affinities may be fully exercised, the law as regards these two, and (as we shall see afterwards) the energy consequent upon this law, may be made fairly evident, and utilised in manufacturing industries as well as calculated with mathematical precision.

Let two be taken—any two—say, the gases oxygen and hydrogen. Place what we may call equal quantities of each apart from all other elements. Cause them to combine. It would be soon observed—*i.e.*, if the experiment were repeated frequently—that this combination is not arbitrary, it is not at the experimenter's option. Although he may put different quantities of these gases in juxtaposition, yet by some means, and, for some reasons unknown to us, they unite only in definite proportions. If more than 11 ozs. of hydrogen be offered to 88 ozs. of

* The Cantor Lectures, delivered before the Society of Arts.

oxygen, the excess of hydrogen will be left uncombined, also the reverse.

As a case of estimation by measure, the nature of the affinities, their intensity, and the inexplicable results produce a comparison which is very striking; *e.g.*, 24 parts by measure of common salt contain 25·8 parts of sodium and 30 parts of liquid chlorine. Such condensation—that is, the condensing, into (say) 24 cubic inches of solid matter, so much as nearly 56 cubic inches—would require the exertion of a very great mechanical force. To appreciate this, it must be remembered that the salt, the sodium, and the chlorine are all under the same atmospheric pressure, and consequently, were there not certain inter-relationships among their constituent elements, of which we know nothing, such change of volume could not be accomplished.

The exercise of affinity, although definite as regards the proportions of the bodies influenced by it, is not called into action without either previous certain surroundings or the creation of influencing surroundings, such, for instance, as the presence of moisture or heat, or light or electricity. If, for example, we take these two white powders which are here mixed together, and add a little water to them, their affinities begin to operate, and a violent effervescence takes place. Again, the states of solid, liquid, and gaseous vanish under the energies of affinity. Mr. Wills will mix two gases, and they immediately form a solid. Now we will put two liquids together, and we find that they become converted into solids. In another case you see that the contact of two bodies suffices to change their state. If a little iodine is put upon this plate, and then a little phosphorus is added, the affinities are manifested by ignition, and the solids pass into the gaseous state. Nor are changes of state and temperature the only attendant phenomena of the energy of affinity; electrical phenomena are often, if not always, present, although not always observed.

It is not improbable that, if the energy of affinity is ever measured and brought within our means of calculation, it may be done inferentially, through some of these collateral manifestations which have not yet been so carefully observed, employed, and tabulated, as their importance would seem to justify. What it is that influences these affinities is as far beyond our present knowledge as to tell what it is that influences many of the affinities of social life amongst the thirteen children. The chemist not only endeavours to establish new relationships, but also to disentangle the relationships which affinities have already established. He fails to-day, he succeeds to-morrow. With bodies thus by the energy of affinity compounded and interlaced—

> ——"In mazes intricate,
> Eccentric, intervolved, yet regular
> Then most, when most irregular they seem."

—we all are concerned. Although we know not their laws, we do know that they partake of the Medo-Persian character—they change not—and, therefore, if once discovered, they are to be relied upon under all circumstances.

This Medo-Persian character of the laws which govern the energies of the affinities introduces into any calculation of them, when and where they are known, a precision and means of repetition, which give thus far to physical chemistry the character of an exact science. With a precision equal to that of the laws of gravity, it is found that in respect to combining proportions there is a mathematical order, perfect and exact. True, articles may be mechanically mixed in any proportions; they can be chemically combined only in definite proportions, and it is only when thus combining, in the chemist's sense of the word, that the "principle of least action" is brought into operation in affinity, and its results as economically utilised by men as the results of the energies of gravity and vitality were described to be in the last two lectures.

In mixtures the particles are still separate, and in many cases may be distinguished under a microscope. Here is an instance. If this bottle is opened, the character of the whole contents is changed. The mixture of the atoms of the air with the nitrogen gas changed the appearance of the mass instantaneously. Again, you are all aware that coal gas burns in air, but we can also make the air itself appear to burn. In the presence of such experiments, it might become a question whether we burn gas in air, or whether we burn air in gas. Here is a cork through which are passed two small glass tubes. One of these tubes is connected with the gas of the room by this flexible india-rubber pipe, the other is open to the air. Now, light the gas issuing from the small tube. Here is a glass chimney, similar to those used with paraffin lamps. The cork has been fitted into the chimney. Place the chimney on the cork, the jet of gas burns as before. Let the supply of gas be increased, the consequence is that the chimney is soon filled with an atmosphere of coal gas; and observe, when a certain quantity of gas has entered, the flame quits the glass tube and now appears upon the air tube. Apparently air is now burning with a pale blue flame in an atmosphere of gas, whilst the gas issuing from the top of the chimney may also be ignited, and will burn in the air of the room. At the top, then, there is coal gas burning in air; and within, air is apparently burning in coal gas.

Again, for example, if gunpowder be taken and well washed, the nitre may be dissolved in hot water, and if the water be evaporated the nitre will be found as ordinary crystals; further, if heat be applied, the sulphur may be sublimed, and then pure charcoal will be left, or the sulphur may be dissolved out by bisulphide of carbon. Thus we can get the three elements of gunpowder, and find they are what they were at first. On another process of manufacture, if the nitre be fused in a crucible, and sulphur added, there results an entirely new substance—sulphate of potash; if to the heated mass charcoal be added, there is formed carbonic acid, and this, with the potash, forms carbonate of potash. No washing or warming will separate these latter combinations. They are for all purposes entirely new substances; they are no longer a mixture, as gunpowder is, in which the affinities may by a spark be called into play, but they are in a combination in which the affinities have already done their work, and that under the influence of continuous heat and without explosive violence, and, therefore, no further development of affinities, either with or without the energy of explosion, can take place.

The utilisation of gunpowder, then, is the result of a process of mixing, such mixing being designed to facilitate the action of several affinities, by placing the elements of the composition in close approximation, ready at a signal from a controlling agent to operate. It seems reasonable to say that the closer these elements are to each other the greater will be the facility with which combinations may take place, and, therefore, the more readily can the affinities be utilised. Such *à priori* reasoning is not confirmed; no simple mixture of impalpable powder, however intimately the dusty particles may have been mingled, fulfils the condition required in gunpowder. It is possible, however, so to diffuse such impalpable powder in the air of a room as that each minute portion is surrounded with an atmosphere of oxygen. If when thus diffused explosion by detonation of any group of particles takes place, the entire mass may explode. In mills for the grinding of madder this accident has happened so frequently as to require special precautions. Herein is an example of many cases in which, whilst admitting our thorough knowledge of the premises on which our reasonings are based, we are found at fault when we apply the knowledge; consequent, apparently, upon ignorance of certain even unsuggested peculiarities in the affinities involved.

Some of you may remember that in July last there was a very serious accident in a flour-mill at Glasgow. Property was destroyed to the value of £18,000 or £19,000, and nineteen lives were lost. But how it happened, or

why it happened, no one knew. The fire insurance companies deputed two scientific gentlemen to investigate the matter thoroughly. and they came to the conclusion, rightly or wrongly, that flour diffused through the air in the mill had become so uniformly or minutely mingled with the oxygen of the air, that the atmospheric contents of the room or rooms were in a state of what may be called gaseous gunpowder. The effect of a spark from the millstones or the machinery caused explosion of the aërial gunpowder by that most violent of all means—detonation. Such a conclusion of such a probable danger being only now surmised, shows how little we know of the energy of affinity. In this mill appears to be an example of the production of explosion from hitherto unsuspected sources.

We have in this bottle a diffused substance, and it is diffused in a liquid which rapidly evaporates. A piece of paper is immersed in the liquid, and we will now allow the paper to dry. When that is nearly accomplished the combustion of the paper with flame occurs, owing to the non-vaporisable solid being so minutely subdivided that the oxygen of the air is in contact with many atoms of the same material, and so energetically unites with them as to produce flame.

To apply the information already communicated to gunpowder may perhaps make as clear the influence which a more detailed knowledge of affinities would give than any other instance. The action of gunpowder is simply this: in a condensed material are many gases, we will speak of these gases as one—*a gas*. The utilisation of gunpowder might at first sight appear to depend upon having the largest amount of gas in the smallest solid space.

Now, without entering upon any chemical question, it may suffice to say that, in this mixture of nitre, sulphur, and carbon, are all the elements for (what we may name) the completion of the energies, though every other substance were excluded. We have here a jar of water, and if into that we put a mixture of gunpowder which has been ignited, you will find that water has no power to put an end to the combustion; it takes place as well under water as in air. From such reasoning and experiments as these, it might be anticipated that the cubic inch of gunpowder which on ignition produced the greatest number of cubic inches of gas would be the most valued. This so apparently satisfactory conclusion is very seriously in error. The amount of heat developed, and the rapidity with which the gas is formed, are important elements in guiding as to the mode of utilising the affinities called forth amongst nitre, sulphur, and charcoal. If the affinities are so intense that the development of all the heat and gas consequent upon the exercise of the affinities through the entire heap is instantaneous, then explosion of a very violent and destructive character takes place. Such an explosion for mining, and doubtless other, purposes, would entail serious loss—the rock, or the shell, would be so shivered as to be simple dust; our coals would have to be as artificial fuel, for the powder produced must, by tar, rosin, or other ingredient, be formed into lumps. To loosen and disintegrate, but not to destroy, are the general requirements for blasting or mining. If the rate at which the affinities in the mass are permitted to come into play can be regulated, and so either retarded or accelerated, then the modes of utilising them may be planned. For example, if a ball is to be sent from a gun, that law should, if possible, be impressed upon the affinities which Nature has impressed upon the energy of animal vitality. A horse accomplishes the dragging of a load by slow beginnings, a locomotive does the same, affinities must do the same. Hence, the development of the greatest intensity of affinity in the case of a gun should be progressive until it attains a maximum, and the time occupied in so doing should be determined by the rate of travel of the ball and the strength and length of the gun.

Other cases, such as the blasting of rocks, demand a very different exercise of affinities. Here the object is simply to disturb, to unsettle, to break up; motion of the pieces to a distance is not required. Considerations such as these, simple as they may appear, are full of perplexity, consequent upon our ignorance of that in which these affinities consist.

Similar remarks apply to gun-cotton, dynamite, nitroglycerine, litho-fracteur, or any of the explosives which modern science has formed.

It is from an attempt to impress upon the affinities a law of time in their exercise that the various forms and compositions of gunpowder owe their origin.

We are much obliged to Mr. Abel, who has kindly lent the Society of Arts different samples of gunpowder. There is one bottle containing powder the grains of which are nearly half an inch cube; there are various other forms, the object of these various forms being to develop the affinities at a rate to be determined by the purpose for which the respective gunpowders are to be employed.

The pressure at the time of explosion has been estimated at more than 4000 atmospheres, *i.e.*, more than 4000×15 lbs., or 60,000 lbs. per square inch. This statical pressure, being converted into a kinetic or velocity estimate, is more than 216 tons lifted 1 foot.

(To be continued.)

CORRESPONDENCE.

THE ENDOWMENT OF RESEARCH.

To the Editor of the Chemical News.

SIR,—I have just read your remarks on the above subject contained in the leading article of the CHEMICAL NEWS of Sept. 12, and with many others share the apprehension there expressed. Without claiming any degree of unnatural purity for the votaries of science, we may venture to affirm that *hitherto* no class of men have been more free from jobbery than scientific investigators. I suspect that this is owing, in a great measure, to the fact that "research *is* unremunerative," and therefore has no attractions for the jobbing classes, or for those who are unable to work hard and live frugally. The man who thinks it essential to his dignity and happiness to have "an establishment," and to join the race and rivalry of modern sensual expenditure, is not likely to devote himself to pure science, and science can do well enough without him.

If we are to have *prospective* payment for scientific research in the shape of fellowships, &c., we may be almost certain that dodgers, jobbers, fawners, and sneakers of all sorts will be attracted thereby, and the distribution of the scientific endowments will become as corrupt and disgraceful as the sinecures attached to our ancient cathedrals. Let us rather fall into abject poverty than sink so low as this!

At the same time, it is unquestionably true that, as science advances and the simple problems become already solved, the cost of apparatus and sacrifice of time demanded by the more recondite objects of scientific research continually increase, and place such investigations quite beyond the reach of men who have to earn their daily bread by daily teaching. As these constitute the bulk of qualified scientific workers, the pecuniary difficulty is practically the chief existing impediment to the progress of science, and consequently of civilisation. How, then, may such men be aided without being corrupted, and without a bait being held out for the enticement of "scientific Micawbers"?

I think this question may be answered at once. Let us have a fairly liberal endowment of scientific research based upon the principle of *payment for results*. This is the sound and natural principle which, by natural selection, has come into operation for the general remuneration of useful human efforts. Other men are paid for work done; why, then, should scientific workers be remunerated

otherwise? Let us suppose a case; or, to put it more pointedly and practically, I will take an actual case on which I can speak definitely. I have made and published certain preliminary investigations "On the Diathermancy and Transparency of Flame and their Consequences." These open out an extensive field of further research, which I am prevented from exploring by stronger claims than those of science, viz., duty to my own family. I cannot afford to expend £40 or £50 on apparatus, and devote £100 or £200 worth of time to unremunerative research; but if there were a market for the results of such scientific research only equal to the market which I can find for scientific teaching and scientific literature, then I might devote some of my small capital to the apparatus of research, just as I do to the purchase of diagrams and lecture apparatus, and I could also afford to give my labour in advance, just as I now do in delivering a course of school lectures payable at the close of the school term. Every other reasonable man who desires no sinecure and seeks no more than the modest income of a teacher would gladly do the same, and willingly incur all reasonable risk of failure, provided his work, when done, were fairly valued by a competent and impartial tribunal.

I have thus illustrated my argument by my own case simply because it is a truly typical one representing the actual position of the great majority of qualified scientific workmen.

If a fund for such payment of scientific research existed, the genuine worker might send in his bill with the paper communicating the results of his researches, and such a bill, after being fairly taxed, should be paid, like any other honest account, in a simple and business-like manner. The man who makes a pair of shoes supplies the want of a single individual, and is paid accordingly by the recipient of the benefit. The toiler in the workshop of science who reveals a new truth is a benefactor to the whole of mankind, has a fair and honest claim against the whole human race, and is entitled to draw a bill accordingly, which should be accepted and honoured by his own country at least. Decent gratitude and common honesty demand so much from the nation. It should be done, and may be done, without opening a door to jobbery or any multiplication of corrupt and idle pensioners.

It is just possible that a few superfine gentlemen may be shocked at such commercial treatment of science, but some considerable experience among men of all sorts has taught me that these superior creatures who affect a contempt for trade and traders are, with very few exceptions, a set of lazy humbugs, who are distinguished from honourable men of business by their unscrupulous readiness to obtain money by any means rather than honestly earning it. I therefore dismiss their objections without further notice.

Those who have the advantage of leisure and independent means may, of course, still enjoy the honourable privilege of nobly devoting themselves to the highest of human pursuits, and freely presenting their fellow creatures with the results of their industry. The more fully and publicly are the claims of science recognised, the greater will be the number of such distinguished men.

Who, then, should pay the wages of the scientific workman? The nation, undoubtedly; but before we can expect this to be initiated by Government, we must be represented and ruled by men who have sufficient scientific knowledge to be able to appreciate the importance and the claims of science. In the present state of our Universities the prospect of this is somewhat remote. In the meantime we have more to hope from private action than from Government help. In a nation where there is so much public spirit that millions are expended in "improving the breed of horses," in spite of the turf abominations with which this effort is associated, where noblemen and other millionaires can be found who will devote tens of thousands in a single season to support an opera house or a theatrical leg-show, there surely need be no difficulty in raising a sufficient fund for supplying the immediate wants of scientific progress. I say the *immediate* wants, believing that it would be very demoralising to the nation if the performance of a primary national duty were permanently left to private generosity. If, however, the work were started by private effort, if its efficacy and the possibility of carrying it out without jobbery were proved, then any intelligent Minister of State might take it up, and enable the whole nation to deal justly and honourably with the most useful of its servants, instead of meanly appropriating their unrequited services, as the mighty empire of Great Britain is now so disgracefully doing.

W. MATTIEU WILLIAMS.

Woodside Green, Croydon,
Sept. 15, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, September 1, 1873.

On Auroræ Boreales, apropos of a Recent Memoir by M. Donati.—M. Faye.—Donati seeks the explanation of auroras in a meteorology which he terms cosmic. The phenomena are probably due to electro-magnetic currents going from the sun to the planets, their vehicle being the ether. M. Faye, hesitating to accept this view, directs attention to the forces really acting in interplanetary space. In addition to attraction there is the force producing the phenomena of comets. Might not this, operating on our earth, give rise to auroras? The effects of this repulsive force are proportioned by surfaces and not by masses. Insensible in very dense bodies, they become enormous in matter of extreme tenuity. Hence the immense comets' tails of 30, 40, and 60 millions of leagues having a direction away from the sun. These rarefied matters have a very high velocity, as if solicited by a force twelve or fifteen times greater than that of gravity. Spectral analysis shows that comets have two kinds of light; one from solar illumination, the other proper to them, and characterised by bright lines of a discontinuous spectrum, indicating incandescence of gaseous parts. The earth, too, viewed from afar would present two spectra; that of solar light, and in the obscure part near the poles the discontinous spectrum of its auroras, boreal and austral. The author does not think the feeble incandescence of cometary matter is caused by solar heat, for the same rays do not produce such effects with us. If a screen were placed across the tail, the particles striking it would likely become suddenly incandescent. Now the nucleus is just such a screen; against which the anterior molecules of the nebulosity strike, producing heat and light; while, on the other hand, molecules not thus arrested pass rapidly behind and from the tail. Thus there is a double effect. On our globe only the extreme and very rare layers of atmosphere have some analogy to these cosmic nebulosities, but they may give rise to some of these phenomena; not tails indeed, for the greater attraction of the globe holds in the matter about it. But they might produce some feeble light-effects similar to those of comets if the repulsive force communicated to them in certain regions a considerable velocity, transferring them to other regions of our globe. The limits of our atmosphere are unknown, but the true limit will be where our

air, having become more rare than the vacuum in our best pneumatic machines, has been reduced to a medium doubtless comparable in density to the cometary nebulosities, on which the repulsive force of the sun acts. Consider this limit; it is not likely spherical. The lower layers of our atmosphere show by the barometer a well-marked minimum of pressure at the poles, and maxima which do not coincide with the equator. Temperature and radiations produce great irregularities in them; and it must be the same with the extreme layers. They probably experience on the side next the sun, the side on which they attain highest elevation, a repulsive force appearing in a slight pressure centrally, and movement at the edges. This limiting layer is thus conceived as having a less curvature, though a higher elevation, than that of the opposite side; and, as in the inferior layers (though in greater degree), presenting a depression near each pole on the right side, where the ground and inferior layers radiate least to the heavens. Then as to the edges of the hemisphere turned towards the sun. The superficial parts, reduced to extreme rarity, obey the repulsive force and are driven tangentially, acquiring considerable velocity in an hour or two. Reaching the depression near the poles they enter the vacuum and rush across it. The earth's attraction produces a strong curvature in their trajectories, and they meet the limiting surface of the atmosphere beyond the depression; and if their velocity may have reached several hundred metres per second, the incessant shock of these mobile particles against the fixed will give rise to light. The slight illumination which will be visible to us in a limited part of the heavens will have the characters of gaseous incandescence. This phenomenon will not occur equally all round the globe. In regions a little removed from the poles there is no vast depression to cross; the molecules in their passage encounter the resistance of a continuous layer, and cannot acquire the same velocity as at the poles. Hence the light will mostly be produced at the poles, and especially at the pole actually deprived of solar light. The author's purpose is not to assert this as the veritable cause of polar auroras, but to show that, apart from the mysterious causes one is tempted to invoke, there is besides Newtonian attraction a real cosmic force which must play some part in our meteorology, and which is connected very simply with the sun itself, and especially with the variable state of his surface.

Note on Siemens's Bobbin.—M. Pellerin.—The chief disadvantage of it is that it develops a considerable amount of heat, and thus work is lost. The heat probably arises in most part, from currents developed by the movement in the metallic mass forming the core. Such currents, which are parallel to the axis of rotation, may be obviated by forming the core of discs of *soft insulated iron*, the combination of which in a sufficiently solid manner is not an insurmountable difficulty.

Changes of Form and the Spectrum of the Comet (1873) IV.—MM. Rayet and André.—On the 26th and 27th August the comet had a circular form of about 6 min. diameter, with luminous condensation in the centre. Its spectrum consisted of three bright lines in green, yellow, and blue, the first being longer than the two others. On the 29th and 30th its diameter was 8 min., and it showed a tail of 25 min. directed away from the sun, and inclined at about 47° to the direction of diurnal motion. The head, still round and with a brighter nucleus, gave a spectrum of three luminous bands as before, but also a faint continuous spectrum. Some peculiarities in the green band are noted. Drawings of the comet are given.

Form of Martial Seas Compared with that of Terrestrial Oceans.—M. Meunier.—According to one theory of sidereal evolution Mars is an older planet than our earth, and now presents features which our earth should present later. The author finds a new indication of the greater age of Mars in the form of the oceans on the planet, which are described by Mr. Proctor as of bottle-necked shape—long and narrow passages. Now if one takes a marine map, such as that of the North Atlantic Ocean, and traces successive horizontal curves for increasing depths, one perceives that these curves tend progressively to limit zones, the form of which is more and more elongated. At 4000 metres, for example, one obtains forms comparable in all points to those of the Martial seas described. Hence, if we suppose the Atlantic absorbed by deep masses actually in course of solidification, so that the surface of this ocean sinks to 4000 metres, we should have a small surface covered with water, and a narrow elongated form of sea exactly as in Mars.

Metalliferous Veins of Cornwall; the Rich Portions of the Veins, the Structure of Such Portions, and their Relation with the Direction of the Stratigraphic Systems.—M. Moissenet.—The author draws the following conclusions:—The parts of the vein whose incline approaches most nearly to a vertical direction are the most productive. The rich portions are commonly, in Cornwall, enclosed in a gangue of moderate hardness. Most frequently the metalliferous bands or columns incline in the same direction as the gangue. The rich portions are frequently disposed according to the direction of the stratigraphical system to which the initial fracture of the vein is related.

Gazzetta Chimica Italiana, Anno III., Fascicolo VII. e VIII., 1873,

Researches on the Nature and Constitution of Tannic Acid.—Ugo Schiff.—The author reviews the previous labours of Berzelius, Strecker, Robiquet, Rochleder, Hlasiwetz, Löwe, &c. He then examines the reactions of tannic acid with the oxychloride of phosphorus and with arsenic acid. The composition of acetotannic acid he gives as—

Carbon	54·2
Hydrogen	4·4
Acetyl	41·5
	100·1

corresponding to the formula $C_{14}H_5(C_2H_3O)_5O_9$. He concludes his interesting paper with an examination of the ellagic and rufigallic acids.

Butyric Acid Generated in Fermentation.—G. B. Grillone.—The author made an extract 5 kilos. of rice in 60 litres of boiling water. After twenty-four hours 60 grms. of malt were added, steeped in 2 litres of milk, 1 kilo. of minced flesh, and 2 kilos. of white chalk. The whole was allowed to ferment in a covered wooden vessel at the summer temperature (25° to 30°). When the development of gas had ceased the liquid was raised to 80°, filtered, mixed with carbonate of soda as long as a precipitate was produced, the carbonate of lime filtered off, and the filtrate concentrated to a small volume and mixed with sulphuric acid, when a considerable quantity of crude butyric acid separated, and was freed from accompanying products by fractional distillation.

Action of Aldehyds on the Bisulphite of Naphthalin.—Dr. G. Papasogli.—Benzoic aldehyd was added to a hot aqueous solution of bisulphite of naphthylamin. The liquid became turbid, and small white crystals were deposited, soluble in alcohol, but insoluble in ether and water. They contain—

Carbon	61·63
Hydrogen	5·13
Sulphur	9·66
Nitrogen	4·27
Oxygen	19·33
	100·02

corresponding to the formula $C_{10}H_9N,H_2SO_3,C_7H_6O$. This benzoyl-bisulphite of naphthylamin loses all its sulphurous acid at a gentle heat, yielding a fusible resinous compound very soluble in ether, moderately soluble in

absolute alcohol, bnt insoluble in water. The ethereal solution on treatment with ordinary alcohol deposits a whitish yellow crystalline powder containing—

Carbon	88·32
Hydrogen	5·62
Nitrogen	6·06
	100·00

corresponding to the formula $C_{10}H_7N,C_7H_6$.

Action of Amides on Phenol.—Dr. Icilio Guareschi.—The author has studied the behaviour of benzamid and acetamid on phenol, and that of benzamid on the salicylate of methyl.

Action of Chloroform on Phenate of Potassa.—Dr. J. Guareschi.—The author, wishing to find a sensitive reaction for detecting the presence of phenol evaporated to dryness, a solution of phenol to which potassa had been added, and the residue while still warm was mixed with chloroform; a splendid purple-red colour was immediately developed. The potassa must not be in excess, nor the temperature very high. The reaction is decisive with 0·1 milligrm. of phenol. The colour is probably due to the formation of rosolic acid.

Synthesis of Conüna.—Ugo Schiff.—This paper is taken from the *Annalen der Chimie und Pharmacie*, vol. clxvi., p. 88, with some additions by the author.

Analysis of a Sulphurous Water from Messina.—G. Mazzara.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Mène, No. 33, 1873.

The only chemical paper in this number is the description of an apparatus for the analysis of gases, patented by M. H. Orsat. A description would be unintelligible without its accompanying woodcut.

Reimann's Färber Zeitung, No. 32, 1873.

In the continued notice of the Vienna Exhibition we find mention of Scheuermann's birling-inks, as distinguished for excellence in quality. We find receipts for dyeing and finishing plushes; for a bright green on wollen piece-goods, flannel, and wool; a medium green on woollen cloth; a dark green for shot-goods; a silver grey, a drab, and a bright salmon on cotton yarn; a green on wool and woollen yarn with Nicholson's blue. This may be produced by boiling the 100 lbs. of goods, previously dyed a medium blue with 1½lbs. sulphuric acid, 3 lbs. alum, and about 1 lb. picric acid till the required shade is obtained. A faster green can be obtained by boiling the same weight for an hour with 3 lbs. alum, 2 lbs. tartar, and 12 lbs. fustic, or young fustic. The latter gives a brighter, but the former a faster shade. There are also receipts for an olive on wool, a dark blue and a bright brown on woollen piece-goods. In the garment, or old materials department, are receipts for a pansy on silk, and a brown on mixed silk, such as silk and satin ribbons.

The following formula is proposed for a chrome yellow on calico:—The pieces are saturated with a solution of sugar of lead (1½ lbs. per gallon), dried, printed with a colour composed of alizarin, red liquor, and acetic acid thickened with starch, steamed for ninety minutes, aged for two days, passed through a solution of 3 ozs. chromate of potash per gallon, handled in a weaker solution of the same salt, washed and brightened with soap. "Anthracen blue" is still flourishing, at least on paper. According to the inventor 25,000 grs. of anthracen yield only 2·5 grs. of this mysterious colour, whence Dr. Reimann calculates its cost at 20,000 rix-dollars (£3000) per lb. The inventor of this same colour gives the following receipt for a black on linen yarns. "To 100 ells take 4 lbs. catechu, 4 ozs. sulphate of copper, and ½lb. potash, and give it a couple of turns at a brisk heat. It is then worked for half-an-hour in a boiling bath of 5 to 6 lbs. of logwood, and 1½ lbs. of sumac, blackened in the same flot with ½lb. copperas, rinsed, finished with starch and tallow or lard (!), dried, and well calendered."

MISCELLANEOUS.

Assay of Crude Phenic Acid.—Hager gives the following process for the assay of crude phenic acid:—5 c.c. of the sample are taken and shaken up with 3 c.c. of a mixture of caustic potash (sp. gr. 1·34) and of alcohol at 95°. (The respective quantities of potash-lye and of alcohol are not stated.) 5 c.c. of essence of petroleum are then added, and the whole shaken again. It is then allowed to settle. When the liquids have separated the volume of the lower stratum is read off. The increase in its bulk shows the amount of actual phenic acid present in 5 c.c. of the sample. The lower stratum consisting originally of the alcoholic potash liquor its bulk was 3 c.c., and all increase is due to the quantity of phenic acid. Schœdler proposes a method of assay based upon the fact that phenic acid when heated combines with sulphuric acid, whilst the latter carbonises the tarry products, disengaging a certain quantity of sulphurous acid. If we add to the products of this reaction of sulphuric acid with crude phenic acid water, and then carbonate of baryta or litharge, there is formed a soluble sulpho-phenate and an insoluble sulphate, which carries down with it the carbonaceous matters, whilst the oily substances separate themselves in virtue of their insolubility. All that is then needful is to precipitate the solution of sulpho-phenate of baryta with sulphuric acid, and to deduce the quantity of phenic acid from the amount of sulphate of baryta obtained. The following are the details of the process:—2 to 3 grms. of the sample in question are taken and heated in the water-bath to volatilise any alcohol that may be present. An equal quantity of concentrated sulphuric acid is then cautiously added, and the mixture is then exposed to a temperature of 50° to 60°. The liquid is then diluted, mixed with carbonate of baryta or litharge in excess, and filtered by decantation. The filtrate presents a yellowish colour. It is decomposed by dilute sulphuric acid; the precipitated sulphate of baryta or of lead is collected and weighed, and the amount of phenic acid is calculated.—*Moniteur Scientifique.*

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in purifying sewage and treating products obtained therefrom for the production of manure. Baldwin Latham, 7, Westminster Chambers, Victoria Street, Westminster, Middlesex. January 28, 1873.—No. 331. This invention consists in utilising the precipitate obtained from sewage in the "alumina," "phosphate of alumina," and other phosphatic processes, and the "magnesia" and "iron" processes for treating other sewage for the production of manure. The said precipitate is first dried, and after standing some time is treated with sulphuric or other acid, so as to convert the alumina in sulphate and sesquisulphate of alumina and the phosphates of alumina and lime into superphosphates, and also to carbonise some of the organic matter. The compound so treated is then mixed with the sewage, together with sufficient alkali to neutralise the acid, whereupon the resulting alumina, phosphate of alumina, and phosphate of lime, are precipitated, and, at the same time, the flocculent deposit formed drags down the suspended matters in the sewage, while the humus, mould, and carbonised matter of the compound combine with some of the ammonia. The deposit thus obtained may be used as a manure, or it may be dried and treated and be again applied to other sewage, in the above-described manner, in order to obtain a rich manure. The solid matter may be first removed from the sewage by the apparatus described in the petitioner's specification, No. 809, of 1869.

Improvements in the means employed for freeing glass from carbon, grease, or other substances that may adhere to its surface. James Augustine Hartley Toulson, manufacturing chemist, and Thomas Harmer, Leeds. January 28, 1873.—No. 335. Fluoric acid in combination with muriatic or nitric acid, and sometimes other acids; or fluoric acid with water; sometimes a powder is used composed of pumice-stone, slaked lime, salts of tartar, Derbyshire spar, powdered soap, sugar. The invention is particularly applicable to railway-station or other large roofs.

Improvements in lamps and apparatus for burning mineral oils or other inflammable liquids. Joseph Sokolnicki, Clinchor, near Castillon, France. January 28, 1873.—No. 336. This invention consists in com-

bining with the burner of the various forms and arrangements of lamps an evaporating tube, for the purpose of keeping up the supply of vapour from the mineral oils or essences or other inflammable liquids, and thereby prevent the light from becoming small or extinct.

Improvements in lamps for burning heavy oils. John Henry Johnson, 47, Lincoln's Inn Fields, Middlesex. (A communication from Robert Hitchcock, John Morton Sigourney, and William Van Vranken Rosa, all of Watertown, Jefferson Co., N.Y.). January 29, 1873.—No. 356. This invention is directed to the burning of heavy oils in lamps in such manner that a brilliant flame without smoke may be produced without requiring the use of a chimney. To the accomplishment of this object I have found the following instrumentalities requisite:—First, passages or ducts through which air may be conducted both to the exterior and interior of the flame; secondly, mechanism for impelling currents of air through these passages to both the exterior and interior of the flame; thirdly, a deflecting cap or cone placed over the wick with an aperture for the passage of the flame, and so shaped as to direct the external impelled current of air to impinge upon the exterior of the flame.

An improved explosive powder or compound, and the mode of preparing the same. H. H. Murdoch, patent agent, 7, Staple Inn, Middlesex.—(A communication from Baron Victor de Rutenberg, Paris).—January 30, 1873.—No. 360. This invention consists in mixing randanite with nitro-glycerine in order to produce an improved explosive powder. Randanite, which is a hydrated silica, was first discovered at Randanne, in France. According to this invention the randanite is first dried and then roasted at a light red heat. It is then reduced to powder and sifted, and is ready for use as an absorbent for nitro-glycerine. Should, however, the randanite used be very impure, it should before being treated as described be washed in an acid solution. The improved explosive powder is made by mixing the prepared randanite with nitro-glycerine by pouring the nitro-glycerine gradually upon a quantity of the prepared randanite upon a surface coated with gutta-percha or soft metal, and stirring the mixture with a wooden spoon or slice. Or the mixing might be effected in a mixing machine.

Improvements in the manufacture of manures. John McDougall, of the firm of McDougall Brothers, manufacturing chemists, Manchester and London. February 1, 1873.—No. 393. This invention has for its object improvements in the manufacture of manures. I treat phosphatic substances with sulphuric acid to render them soluble and remove the soluble constituents (either whole or in part) by washing, filtration, or other convenient method, and into the resulting solution I pass liquids, gases, vapours containing ammonia, and the resulting product may be concentrated or dried by exposure or heat. Or, after passing ammonia into the resulting solution as herein described, I allow the precipitated phosphate of lime to subside and separate the liquid, which can be evaporated into a salt. The precipitated phosphate can be dried for use or incorporated in the semi-liquid state into the manufacture of superphosphates as hereafter described. The solution obtained as herein described may be used for the removal of ammonia in coal-gas or other gases arising from the destructive distillation of carbonaceous substances, by employing it in the ordinary washers or scrubbers in use in gas-works, or by other convenient method. I also treat phosphatic substances with hydrochloric acid in any desired quantity to render them soluble; if sufficient of the acid has been added to convert the phosphate into the liquid state, any insoluble residue may or may not be removed by subsidence or other convenient method; and into the mass or liquid I pass gases or vapours containing ammonia other than coal-gas. The resulting product can be concentrated by heat or exposure. Or, in treating the phosphatic substances with hydrochloric acid as above described, I take care the acid is of reduced strength, or, if acid of full strength is used, the resulting solution may be diluted, so that, after passing in the gases or vapours containing ammonia, the resulting solution shall not be too dense to allow the soluble phosphate that has become changed into precipitated phosphate to subside, so that the liquid may be run off and evaporated into a salt, and the precipitated phosphate dried for use. In the manufacture of superphosphate of lime for manure, when sulphuric acid is used, it is customary to dilute the acid with water when bringing it into contact with the phosphate to be acted upon, by which means a drier product is obtained than if acid alone were employed. This water, either whole or in part, I substitute with liquids or semi-liquids containing ammonia or other useful manurial ingredients, and so utilise them, at the same time obtaining a manure of sufficient dryness. If the liquid used requires the addition of an acid for its proper utilisation, the acid must be added to it before using, or extra acid added to the phosphate. After the removal of the soluble constituents from the phosphatic substances treated with sulphuric acid as already described, the residue will consist to a large extent of sulphate of lime, this sulphate of lime, or sulphate of lime obtained by other methods or in a natural state, or chloride of calcium, I treat with liquids containing ammonia, and whilst agitated pass in carbonic acid, which causes the decomposition of the sulphates or chlorides, and liberates the acids to combine with the ammonia. After subsidence, I separate the resulting solution and evaporate it into a salt. The carbonic acid generated in the treatment with an acid of phosphatic substances containing carbonate of lime may be utilised for this purpose, or may be derived from other convenient source. When it is desirable to convert the precipitated phosphates obtained by the foregoing process again into soluble phosphates, either wholly or in part, I add sulphuric or any suitable acid to effect this purpose.

NOTES AND QUERIES.

Water Free from Ammonia.—Being in frequent use of Wanklyn and Chapman's "ammonia process" in water analysis, I have found the preparation of "ammonia-free" water, for comparison, to be a tedious and troublesome operation, especially if required in large quantities; an accidental discovery has, however, relieved me from further inconvenience upon that score. I have in my laboratory a copper drying oven heated by steam from a boiler. The oven is secured against excessive radiation by an outer case of wood, but, notwithstanding this, there is a considerable amount of condensation goes on in the copper jacket of the oven, and I find that the resulting water is free from every trace of NH_3; thus I have a constant supply of water, which only requires cooling to render it fit for even the most delicate determinations. The high temperature at which the steam is condensed is evidently the cause of the purity of the water.—W. F. K. Stock, F.C.S., Laboratory and Assay Office, Wooler Street, Darlington.

TO CORRESPONDENTS.

H. H.—"Jetoline" is a peculiarly made aniline black. Methods for using it in photography have been described in photographic periodicals.

A. P.—The following is the prescription for hydrosulphite of soda, as given by Schützenberger and Risler:—Allow 30 grms. of bisulphite of soda at 30° Baumé to act on zinc turnings, air being excluded. After about half an hour, 50 to 100 grms. of milk of lime are added containing 200 grms. of quick-lime per litre. It is then diluted with 5 litres of water, shaken up, the clear liquid decanted, and preserved in small bottles completely full, well stoppered, and inverted under water.

J. Wilson.—As the wool has been already treated with sulphuric acid, it is not likely that any substance will, without either destroying the woollen fibre, or altering it so as to render it worthless except as a manure, discharge the dark colour from the wool, which cannot be treated with chlorine or similar agents; still you might try the action of sulphurous acid gas, which might to some extent bleach the dark coloured wool, which appears, however, to have been dyed with fast colours.

THE
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THE CHEMICAL NEWS.

Vol. XXVIII. No. 724.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Bradford Meeting, 1873.

SECTION B.—CHEMICAL SCIENCE.

President, Dr. W. J. Russell, F.R.S.

"*The Purification and Utilisation of Sewage.*" Mr. R. B. Grantham, C.E., brought up the Report of the Committee of the Association on the Treatment and Utilisation of Sewage. The meetings of the Committee had been attended by Mr. Grantham, Professor Corfield, Mr. J. H. Gilbert, Mr. W. Hope, and Professor A. W. Williamson. The Committee srated that it had continued that part of the inquiry for which it was particularly reappointed last year, viz., the examination of the typical case of sewage farming at Breton's Farm, near Romford. Tables similar to those of last year were again supplied. An analysis had been made of the soil of the farm, showing a considerable increase in the amount of nitrogen and of phosphoric acid. A further examination had been made of the sewage farm at Earl's Wood, with more satisfactory results than before. Dr. Gilbert had again furnished a note on the dry earth system. Whitehead's process had been for a few days at work on a considerable scale at Enfield. The Local Government Board had obtained returns of loans for sewage farms, conducted by local authorities. The information in those returns would be valuable if exact. A radical defect in them was that there was no separation of capital from working expenses, and the cost of land was lumped with that of the works.

Mr. Hope read an elaborate report on Breton's farm at Romford. Systematic observations had been continued and summarised in tables corresponding to those of last year. Many of the results thus contrasted were instructive; but the tables, although themselves only summaries, were so voluminous that it was impossible adequately to describe them. The points of chief importance were that the effluent water was slightly purer, thus exploding the nonsense sometimes talked about land becoming "sick" of sewage, that an analysis of samples of the soil taken in April, 1873, at the same part of the farm as the samples were taken from for the analysis of 1870, prior to the application of any sewage, showed very appreciable quantities of phosphoric acid, ammonia, and nitric acid, when valuable manures were almost indeed practically absent in the same soil in 1870. The committee also found that the population of Romford had been largely overstated by the Local Board, and that instead of between 7000 and 8000 persons feeding the sewers there were only about 4600 persons in all. This, of course, gave a very different complexion to the agricultural results, and, amongst other things, gave the new and important fact, that in the case of the town the sewage of the population, including, of course, kitchen and washhouse slops, and that due to horses and to live-stock on market days, contained 13·14 lbs. of nitrogen per head per annum.

Professor Corfield gave the substance of an abstract of all the reports which had been presented to the Association by this Committee since its first appointment. The final opinions of the Committee were in substance as follows:—

I. All conservancy plans, including midden, heap, and cesspool systems, dry ash, and dry earth closets, pail closets, &c., are quite incompetent as solutions of the general question of the removal of the refuse matters of a population; they only deal with a small part of the liquid manure; towns which resort to one of them require to be sewered, and the sewage requires to be purified. The manure produced is in all cases (except in that of pimple pails or tubs, where no extraneous materials are added) poor, and will only bear the cost of carriage to a short distance, taking into consideration the cost of collection, that produced by the dry earth system being, even after the earth has been used three times over, merely a good garden mould. Moreover, these plans all violate one of the most important of sanitary laws, which is that all refuse matters which are liable to become injurious to health should be removed instantly and then be dealt with afterwards. With all these plans, it is an obvious advantage on the score of economy to keep the refuse about the premises as long as possible, and the use of deodorants of various sorts, or even of disinfectants, proves that this is the case, and that these systems all depend upon a fallacious principle. They should therefore be discouraged as much as possible, and only resorted to as temporary expedients, or with small populations, in very exceptional instances.

II. The water-carriage system, on the other hand, is based upon a sound principle, that of removing all the refuse matters at once and in the cheapest possible manner by gravitation, and ought to be resorted to in all but the most exceptional cases. The opinion of the committee that all sewers should be made of impervious materials, and that separate drains to dry the subsoil should be constructed where necessary, has already been most emphatically expressed. The freest possible ventilation of sewers, house drains, and soil-pipes, in order to prevent accumulations of foul air, is also essential. With regard to the utilisation of sewage, the Committee has come to the conclusion that the precipitation processes that it has examined are all incompetent, and necessarily so, to effect more than a separation of a small part of the valuable ingredients of sewage, and that only a partial purification is effected by them. Some of them may, however, be useful as methods of effecting a more rapid and complete separation of the sewage sludge.

The upward filtration process only effects a clarification of the sewage, and is, therefore, no solution of the question.

Weare's charcoal filtration process, as carried on at Stoke-upon-Trent Workhouse, did not give satisfactory results, the effluent water being in effect weak sewage; an opportunity will, however, soon be given for an examination of this process in a modified form on a much larger scale at Bradford, and under more favourable conditions. Intermittent downward filtration through soil has been shown at Merthyr Tydfil to afford a means of purifying the sewage under favourable conditions, but it cannot be said to be a method of utilisation except to a partial extent, as the investigations made by the Committee showed that the effluent water contained as much nitrogen as was originally in solution in the sewage, but mainly as nitric acid, instead of as ammonia and organic nitrogen; and there can be no doubt that the process will prove useful as an adjunct to irrigation, or where a sufficient amount of land for irrigation cannot conveniently be got.

By properly conducted sewage irrigation a solution is afforded to the question of sewage utilisation; it has already been stated that a precipitation process, or some clarifying process, may be found useful; in all instances it is essential that the land should be well underdrained, and that the sewage should all pass through the soil, and not merely over it; otherwise, as has been shown, it will only occasionally be satisfactorily purified. The catch-water, or, as the Committee has termed it, the "super-saturation" principle, is not defensible either on agricultural, chemical, or sanitary principles; an irrigation farm should therefore carry out intermittent downward filtration on a large scale, so that the sewage may be always thoroughly purified, while at the same time the maximum of utilisation is obtained.

It is certain that all kinds of crops may be grown with sewage, so that the farmer can grow such as he can best sell. Nevertheless, the staple crops must be cattle food, with occasional crops of corn; and it is also certain from the analysis of the soil that it has become very much richer, and that the manurial constituents of the sewage accumulate in it. Cattle should be fed on the farm, which leads to a vast increase in the production of meat and milk, the great desiderata of the population producing the sewage. Thus the system of farming must be specialised and capital concentrated, the absence of which conditions has proved a great barrier to the satisfactory practical solution of the sewage question.

The Committee has not been able to trace any ill effects to the health of the persons living around sewage farms, even when badly conducted; nor is there any proof whatever that vegetables grown thereon are in any way inferior to those grown with other manure. On the contrary, there is plenty of evidence that such vegetables are perfectly suited for the food of man and beast, and that the milk given by cows fed on sewaged grass is perfectly wholesome; thus Mr. Dyke, Medical Officer of Health of Merthyr Tydfil, states that since the abundant supply of milk from the cows fed on irrigated grass the children's mortality has decreased from 48, 50, and 52 per cent of the total deaths, to only 39 per cent, and that so far from diarrhœa having been made more prevalent by the use of sewaged cabbages, "last year the Registrar-General called attention to the fact that diarrhœa was less prevalent in Merthyr than in any place in England and Wales;" and he expressed his belief in "the perfect salubrity of the vegetable food so grown."

With regard to the assumption which has been made that entozoic disease would be propagated by irrigation, all the evidence that the country has been able to collect, and more especially the positive facts obtained by experiments, are against such an idea, and the Committee is of opinion that such disease will certainly not be more readily propagated by sewage irrigation than by the use of human refuse as manure in any other way, and probably less if the precaution be taken of not allowing the animals to graze, but always having the grass cut and carried to them.

"*The Sewage of Manufacturing Towns.*"—Mr. W. T. McGowen (the Town Clerk of Bradford) read a paper on the above subject, in the course of which he said:—There are few subjects connected with the management of large towns which cause greater embarrassment than that of the disposal in a satisfactory manner of their sewage, especially when it contains the refuse of establishments engaged in the manufacture and dyeing of textile fabrics, where the surrounding district is extensively occupied with dwellings, or the surface is affected by serious variations of altitude. Local authorities are frequently charged with supineness in relation to this branch of their duty; but they are not open to the imputation, and if they were there are influences in operation sufficiently active to forbid all chance of their being allowed to slumber. As a rule they are willing to incur any reasonable trouble or expenditure. The difficulty lies in another direction; they are in perplexity as to what is the proper course for them to adopt; and in the whole range of inquiry to which the labours of the British Association are directed, nothing would confer a greater boon on the country than the settlement of this question in a thoroughly practical manner. The stages by which the matter has assumed its present aspect do not admit of much controversy; the growth of population and the evils arising from neglect of sanitary requirements.

Mr. McGowen then went on at some length to speak of the stages by which the matter has assumed its present aspect; of the difficulties that have to be encountered by large towns; and of the recent attempts to legislate upon the subject. He then referred to the report obtained last session by the President of the Local Government Board, showing what has been done in reference to the purification of sewage in specified parts of the country. The processes employed are arranged under the heads o Sewage Farms, as adopted in 45 towns; Filtration, as adopted in 54 towns; and Precipitation, as adopted in 30 towns. These do not comprise every place where endeavours are made to deal with sewage, because Birmingham, which has been severely tried, is not even mentioned. The report shows conclusively that the whole subject is yet imperfectly understood, and that what is done is chiefly of a tentative character. The largest town in the list, Leeds, relies on precipitation; but this has been in operation only one year there; and Wilsden, the town which has longest tried a sewage farm, that is from thirty-five to forty years, cannot have achieved a great success, because it is stated in the report that the sewage is merely run over the land, and that on one occasion, when it escaped into the river Peuk, it led to complaint. In none of the cases is sewage in very considerable quantity subjected to treatment. It would be unfair to the gentlemen who advocate the irrigation system to test their views by what is done at Wilsden, because it is admitted by those whose judgment is to be respected that for sewage farms to be efficient the subsoil of the land must be prepared to a proper depth, and with proper material, or not only will the rainfall fill the land with water, and thus reject the sewage, but the sewage will fail to answer the intended purposes of imparting its fertilisers to the earth and the roots of plants, and then passing away purified. On the other hand, it would be equally unfair to local authorities of places like Bradford, and Leeds, and Halifax to assert that what may answer well at Romford or Worthing must necessarily be applicable to them. The difficulties of applying irrigation schemes to the manufacturing towns of this district are most serious. Sir William Denison, when he sat on the Rivers' Commission at Bradford, being asked how much land would be required for the irrigation of the sewage of that town, replied "Ten thousand acres." There is no such quantity of land to be got in the district except at much higher levels than the sewage; land is extremely dear: and being more or less occupied with good dwellings irrigation would lead to endless litigation for nuisances. Any application to Parliament for power to make a large sewage farm in the neighbourhood would share the fate of the Birmingham bill. The irrigation, if resorted to, must therefore be at a great distance, and for every yard of land required for conduit extortionate claims for compensation would be set up; the cost, including arbitration expenses, would be absolutely ruinous; and, moreover, the waters would be thus withdrawn from their natural course, where they are indispensable, the streams they now supply, though with an objectionable contribution, would cease to exist, and the industries of the district would be paralysed. Bradford, having been taken in Chancery, agreed to use her best efforts to defecate the sewage of the town. Her case is a good illustration of the capricious state of the law. The sewage is discharged into a stream (the Bradford Beck) for the condition of which she is not answerable; and Dr. Letheby, on a comparative test of the impurity of the sewage and the impurity of the beck, found the latter the worse in the proportion of three to two. The sewage actually improved the waters of the beck. The Corporation, however, could not deny that they sent sewage into the river Aire. They therefore submitted to the above arrangement, and they have spared neither pains nor money to perform it. They carefully considered the best course they could adopt. For the reasons already given, they found sewage farming to be impossible, and they also found that precipitation by the lime process would plunge them into increased trouble, for although the sewage could be cleansed, such an amount of semi-liquid products would be thrown upon their hands as would be beyond their control; the daily discharge of the sewage being about 5,000,000 gallons. After full inquiry it appeared to them the best thing they could do was to contract with the Peat Engineering

Company, by which, under the management of Mr. Danchell, the Company undertake to defecate the sewage, the Corporation providing the requisite works. Without entering into minute details, the process of the Company may be briefly described as being partly filtration and partly subsidence by means of a catchment chamber by tanks and other appliances, to which is conjoined a system of purification by peat charcoal, the power of which constituent over the offensive properties of impure air or water is indisputable. This complex operation is capable of sending off effluent water far beyond the standard of purity imposed on the Corporation, whilst the residual products are made inodorous by the peat charcoal, and are quickly solidified by the mechanical admixture of other ingredients, so as to form a portable manure. From what has already been stated with reference to Bradford, it follows that whether the plan which the authorities have adopted shall prove eminently successful or a complete failure, the effect upon the river Aire will be unappreciable, not only on account of the worse condition of the beck, but also from the fact, to be seen on reference to the accompanying plans, that there are many other places sending their pollutions into the river besides the Bradford Beck. The authorities of the neighbouring districts are fully sensible of their position, and the best proof of their desire to provide an efficient remedy is that in 1871 they united in framing a bill for the conservancy of the Aire and Calder rivers. Instead of meeting with support from those who had cried out against pollution, the bill received their strongest opposition, thirty-three petitions being presented against it. Notwithstanding this hostility, the promoters would have stood their ground, more especially as Mr. Secretary Bruce had promised that the bill should, so far as the Government were concerned, at least have a fair hearing in committee. This promise was honourably fulfilled, on an attempt being made by some of the petitioners to postpone the second reading for six months. The manufacturers at Halifax, who are all potent in that borough, then threatened the Corporation that if they spent any public funds on the bill the Queen's Bench would be applied to for a mandamus. The Halifax Corporation were thus compelled to stay their hand and withdraw. Huddersfield was on similar grounds compelled to follow suit; Leeds was in equal difficulty; and Bradford, being situated only on the Aire, had no case for Parliament as to the Calder, and so the bill dropped. The principle of that bill embodies the result of the care bestowed on the question at the time by the promoters. It is framed upon a broad and liberal basis. Nothing has since occurred to show that it was wrong, and the scheme, with one exception, is now submitted to the consideration of this meeting as that best suited for this part of the country, and equally applicable elsewhere.

Having described the general features of the Aire and Calder Conservancy Bill, Mr. M'Gowen said—The advantage of the system by which the standard of purity would be obtained under such a scheme as that proposed by the Conservancy Bill as against that proposed by the Government bills is, that instead of laying down a hard and fast rule, applicable in some places, but inapplicable in others, an elastic arrangement is provided, which can be rendered suitable for every district and its trade. In fixing the standard some regard should in justice be paid to the condition of the outfall river; otherwise, as was pointed out by noble lords in committee, a manufacturer might be called upon to return water better than he got it, and better than the river into which it is discharged. A high standard might be found impracticable at the commencement of the conservancy, and some degree of forbearance might therefore be necessary; whilst after a given interval the standard might safely be made more severe; or, on the other hand, if found to be too stringent, and consequently mischievous, it could be rectified without the expense and trouble of a fresh Act of Parliament every time a change was wanted. The prime object of the scheme was to put all the manufacturers of the district on the same footing with each other, and render the burden of purification as light on their shoulders, compared with competitors elsewhere, as is possible. No man can fairly deny that the treatment of the sewage of large manufacturing towns is a grave subject. It may be that all tried systems will fail on account of the enormous quantity of sewage to be dealt with, and the limited superficial area of England available for its application. Should this happen, the only remedy would appear to be for the Government to undertake the construction of main outlets to suitable points on the coast, where the refuse could conveniently be used in fertilising wastes of sand, or be got rid off in the sea, leaving the local authorities the duty of conveying their sewage to these outlets. This, however, would necessitate the construction of reservoirs, to replenish the streams whence the waters would be thus abstracted, and as against the cost to the country might be set the advantage of allowing anybody along the course of the sewage channels to use the sewage if he thought fit to do so under proper restrictions. There is an earnest desire existing throughout the country to restore the rivers to a wholesome condition—a desire shared by local authorities as much as by landowners; but the object to be attained must be subordinate to some other important considerations. Manufacturers give employment to vast numbers of men, women, and children, to whom the highest purity of the streams would be comparatively of little moment if their sources of occupation were gone; the home manufacturer is exposed to keen competition with his foreign rival, who can work his servants long hours, and escape from a variety of restrictions to which his British competitor is exposed. As regards town sewage, distinguished from manufacturing pollutions, the refuse must be got rid of somehow or other. It cannot remain in the town; and the Government, when they issued their commissions, were so fully sensible of this that they laid down conditions, which must not be overlooked by those who are seeking after purity, that by whatever means the remedy is to be effected, that remedy must be "without risk to the public health, or serious injury to industrial processes and manufactures." These conditions appear to have been lost sight of in the Lords' bill, and notably so in the circumstance that no new sewage outlet was to be made in a watercourse, or any new use made of an old sewage outlet. This would involve the retention in the town of sewage thus placed under ban until a scheme of purification was devised and executed, a state of things which would be past all endurance. The feeling of the present moment seems to run high in favour of sewage farming. Without disputing for a moment the advantages of water as a medium of transporting sewage, and without entering upon the question of pecuniary results, the difficulties already pointed out show that as to many places the sewage farm is impracticable. To this observation must be added the important general remark that, if 20 acres per soul be about the proper scale for scientific sewage farming, it is doubtful whether sufficient land exists, suitable in point of level or otherwise, for the undertaking. Those who are earnest in the matter, and are animated by a desire to promote the public health in preference to the success of any pet doctrine, should bear in mind the responsibilities they incur in pressing forward impracticable measures. Admitting the fitness of sewage farming properly conducted for suitable places, there must remain enormous districts in area and population where the liquid refuse must be cleansed within a short distance of the outfall. To work out this task effectually mechanical appliances are indispensable; but it is to the chemist we must look for the perfection of the undertaking, especially as enabling the operation to be conducted inoffensively, so as to destroy smell effectively, so as to speed consolidation of products, so as to admit of removal profitably, so as to concentrate the fertilising agents, and satisfactorily as to effluent waters. And whilst provincial towns are being rightly

looked after by the Government, it should not excite surprise if they draw invidious comparisons between the zeal with which they are pursued and the indifference manifested in the metropolis, where a board enjoying almost unlimited taxing power is allowed to discharge the sewage of three million people into one river, under the very nose of Parliament, and in sight of those equity judges whose decrees are fulminated against the country towns, some of which judges, together with many puissant Lords and gentle Commoners, complacently drink their diluted London sewage whilst severely condemning similar impurity in water used only for business purposes in the provinces. If sewage farming on a large scale is the proper thing, we may fairly ask why the Board of Works has not carried the famous Essex reclamation scheme; or if precipitation or filtration be good, why they have not applied it around Abbey Mills, at Plumstead Marsh, with all the advantages incident to having the highest engineering, mechanical, chemical, legal, and scientific skill ready at command. The fact that no attempt is made by such a powerful authority under such favourable auspices to ascertain whether mere domestic sewage on a large scale can be successfully dealt with, so as to yield profit and avoid fouling streams, is an argument, not that other towns with infinitely great difficulties should go unchallenged, but that they should be treated with consideration; that rash indifference should be avoided; that due regard should be paid to manufacturing interests which are of national importance; and that, as attempted by the Aire and Calder Conservancy Bill, the Government should endeavour to promote amicable co-operation amongst the parties interested, in preference to legislating recklessly or harshly, or thrusting down the throats of honest people dogmas which, after enormous expenditure and infinite discomfort, may prove to be erroneous.

ZINCO-MAGNESIC CHLORIDE.

By GEORGE WARNER, F.C.S.

In Chemical News, vol. xxvii., p. 271, I published a brief note on zinco-baric chloride, and at the same time stated that I had prepared zinco-magnesic chloride. It is prepared by dissolving magnesic chloride in a hot solution of zincic chloride to saturation. The solution of zincic chloride should be concentrated until of 1·6 sp. gr. before the addition of the magnesic salt, by this means avoiding the partial decomposition of the latter, which must ensue during the prolonged evaporation necessary to obtain the right degree of concentration for crystallisation. Upon cooling, a crystalline mass is obtained, which, when drained and re-crystallised, produces the double salt in rhombic prisms with truncated summits, of the composition $ZnCl_2,MgCl_2,6H_2O$, or, in 100 parts—

	Found.	Theory.
$ZnCl_2$	40·29	40·15
$MgCl_2$	28·07	28·01
H_2O	31·64 by diff.	31·84
	100·00	100·00

This salt is extremely deliquescent, and, compared with other compounds as hygroscopic substances, was found to stand in regard to them as follows:—The figures represent the proportionate quantity of moisture absorbed from the air in a given time, calcic chloride which has been evaporated to dryness and ground taken as a standard.

Calcic chloride	1·00
Calcic chloride, cryst.	0·52
Zincic chloride, cryst.	1·00
Zinco-baric chloride, cryst... ..	0·40
Zinco-magnesic chloride, cryst...	0·59
Magnesic chloride..	0·43

Ardwick Bridge Chemical Works,
Oct. 1, 1873.

NOTE ON THE LEAVES OF THE BEECH.

By J. ALFRED WANKLYN,
Corresponding Member of the Royal Bavarian Academy of Sciences.

In the course of my experiments on different kinds of leaves regarded as material for making tea, I have observed a very interesting fact connected with the beech. Its leaves yield to boiling water 20·8 per cent of extract. This is reckoned on the absolutely dry leaf. The 20·8 parts of extract yield on incineration 2·44 parts of ash, and this ash, extraordinary to relate, is sensibly charged with manganese. Indeed it is quite green from the manganese which it contains. On being treated with water it gives the characteristic red solution of permanganate, which loses its colour on treatment with oxalic acid. The decoction of beech leaves, therefore, contains a quantity of manganese.

Another fact worth noting is the great fragrance of decoction of beech leaves; possibly it might be used as a beverage.

Returning to the chemical aspect of the subject, I cannot let slip this opportunity of recommending a study of the ash of leaves. It is quite to be expected that some of our common leaves may be found to be charged, not with potash, but with cæsium or rubidium. That cigar-ash is laden with lithia is indeed known. Perhaps a diligent search into the ash of leaves may disclose new elements. Recent research has brought into prominence the selective power of plants which will refuse to draw soda from a soil that is charged with soda, but will select the traces of potash that it contains.

ON TEA.

By J. ALFRED WANKLYN.

There is no doubt that tea is sometimes adulterated with iron-filings and other preparations of iron, and when public analysts have found that iron had been put into tea leaves they have doubtless, in some instances, found that which really had taken place.

The ash of genuine tea leaves, however, contains iron, and by no means a small proportion of it. In a paper by Zöller (Liebig's *Annalen*, May, 1871), the percentage of oxide of iron in the ash of tea leaves is given as 4·38 per cent. The importance of this determination depends upon the circumstance of the tea having been received direct from the growers, who were personal friends of Liebig's; in that instance, therefore, there could be no question of adulteration. It may be interesting to reproduce Zöller's analysis, which is as follows:—

Potash	39·22
Soda	0·65
Magnesia	6·47
Lime	4·24
Oxide of iron..	4·38
Protoxide of manganese ..	1·03
Phosphoric acid	14·55
Sulphuric acid	trace
Chlorine..	0·81
Silica	4·35
Carbonic acid	24·30
	100·00

From this it is abundantly manifest that the mere qualitative detection of oxide of iron in the ash of tea is no valid proof of adulteration; and that in order to make out a case it is necessary to show sensibly more than 4 per cent of oxide of iron in the ash.

On the present occasion I wish to call the attention of public analysts to the importance of investigating the ash of samples of tea. Zöller found the ash of tea leaves to be 5·63 per cent, using in his investigation tea leaves of

guaranteed purity. I find that commercial tea yields a very similar result, as is seen from the following analysis made in my own laboratory :—

	Percentage of Ash.
Specimen of tea used by myself..	5·63
Civil Service tea	5·56
Horniman's tea	5·99
Mandarin's tea, 8s. per lb.	5·30
Orange Pekoe, 5s. per lb.	5·84
Do. do.	6·06
Green tea, 4s. 6d. per lb.	5·86
Average ..	5·75

These determinations were made on tea in its ordinary air-dried condition, and agree sufficiently with Zöller's. The proportion of ash in absolutely dry tea is 5·92 per cent.

Zöller further calls attention to the composition of the ash of spent tea leaves. This, as might be expected, is far less rich in alkalies, being far less soluble. Zöller's analysis is as follows :—

Potash	7·34
Soda	0·69
Magnesia	11·45
Lime	10·76
Oxide of iron	9·53
Protoxide of manganese ..	1·97
Chlorine	trace
Phosphoric acid	25·41
Sulphuric acid	trace
Silica	7·57
Carbonic acid	25·28
	100·00

This ash, as a matter almost of course, must be composed mainly of material insoluble in water.

For practical purposes, that is to say for use by the public analysts, a complete analysis of the ash would be too cumbrous and troublesome. A great deal of information may, however, be gathered from a tolerably simple operation, viz., from a determination of the relative quantities of soluble and insoluble ash in tea leaves. With the object of rendering a determination of this sort available, I have made such determinations on dried leaves of various kinds. The leaves, with the exception of the tea and Paraguay tea leaves, were gathered by my assistant on the 24th of August this year. The following are the results :—

	Percentages on the Dried Leaves. The Ash.		
	Total.	Soluble in Water.	Insoluble in Water.
1. Common tea ..	5·92 ..	3·55 ..	2·37
2. Paraguay tea..	6·28 ..	4·22 ..	2·06
3. Beech	4·52 ..	2·00 ..	2·52
4. Bramble.. ..	4·53 ..	1·84 ..	2·69
5. Raspberry ..	7·84 ..	1·72 ..	6·12
6. Hawthorn ..	8·05 ..	3·78 ..	4·27
7. Willow	9·34 ..	4·16 ..	5·18
8. Plum	9·90 ..	5·66 ..	4·24
9. Elder	10·67 ..	3·19 ..	7·48
10. Gooseberry ..	13·50 ..	7·83 ..	5·67

From this table it will be apparent that the ash of Paraguay tea is the only ash capable of being mistaken for the ash of tea; the total percentage would of itself exclude all the others. The ash of Paraguay tea is, however, distinguished from the ash of common tea by containing a higher proportion of soluble matter.

The ash of beech and of bramble is distinguished from that of tea by being too small in amount, and by containing too little soluble matter. All the rest are exceedingly unlike tea ash.

The determinations of the total, the soluble, and the insoluble ash in leaves are made with great facility. Dried leaves burn up with great ease; and, for the purpose of getting a complete combustion there is no occasion for the employment of nitric acid. I am in the habit of employing about 2 grms. of the dried leaves for the experiment. These I burn in a small platinum dish, and when the resulting ash has become grey, I allow the dish to cool and weigh it together with its contents. The ash is then heated to boiling with a little water, and the solution filtered, and the filtrate evaporated to dryness in a small platinum dish; the resulting residue is then ignited, cooled, and weighed. Thus I get determinations of "total ash" and "soluble ash"; the "insoluble ash" is found by difference.

Sand is sometimes found in tea leaves; this is very easy of detection. It will, of course, remain in the insoluble portion of the ash, and refuse to dissolve when that is treated with hydrochloric acid. The portion of real tea ash which is insoluble in water is almost entirely soluble in hydrochloric acid.

Very many uses may be made of a determination of the ash in a sample of tea. As an example of what may be learnt from such determinations, I will cite an imaginary case, which, however, finds its parallel in practice. Let us suppose that the tea yielded the normal proportion of ash, viz., 5·75 per cent on the air-dried leaves, and let us suppose that one-third of this consisted of sand. With these data before him the analyst would be justified in finding, not only that there was a little sand in the tea, but that at least one-third of the sample did not consist of genuine tea, but either of some other kind of leaf or of spent tea (which is not so rich in ash as genuine tea).

On a future occasion I hope to publish further researches on tea, and will conclude with an expression of my conviction that a little careful chemical work bestowed on the subject of tea will render the examination of it highly certain and satisfactory.

MEMORANDUM ON THE METALS AND MINERALS OF UPPER BURMAH.

By Captain G. A. STROVER, Political Agent, Mandalay.

THE Chief Commissioner having called for a report upon certain mineral products of this country, it has occurred to me that, as many years have elapsed since any concise information has been given upon the subject of metals and minerals generally, and as our knowledge regarding these products has been greatly extended of late in consequence of increased intercourse between the British and Burmese Governments and the subjects of each nation, it will not be out of place, and of some interest, to give a brief sketch of the resources of Upper Burmah as regards the same.

Gold.—It has been generally supposed that Upper Burmah is not rich in itself as regards this metal, but there would seem to be good grounds for supposing that it exists very extensively. In former years the gold used in the country was imported from China to the extent of some 400 or 500 viss annually, but the imports have considerably decreased since the commencement of the Mahomedan rebellion in Yunan, and now do not exceed 200 viss per annum, the deficiency being imported from Rangoon. It is an article largely used in the decorative art, and appears to be generally plentiful.

In the Mogoung district there would seem to be a gold-field that, if properly worked, would prove very productive. Some years ago, a Mr. Golding, of Australian experience, contracted with the King to work 1 square mile of this field for a sum of Rs. 25,000 annually for ten years, but unfortunately the district proved to be malarious, and Mr. Golding succumbed to fever; he, however, pronounced the fields to be equal to any in Australia, if not better. I am not aware that he succeeded in procuring much gold. Since then no attempt has been made on the part of the Burmese Government to work the mines.

To the north-east of Mandalay, in the Shan States, there is another field of gold. My information tends to show that here again, with energy and enterprise, con-

siderable quantities of gold could be extracted, and the mines prove very productive; but the locality at present is malarious, and but little gold is procured.

At Thayet-pein-yua, near the Myit-Nyay, on the road to Pyoungshoo, to the south-east of Mandalay, the gold quartz is found in abundance, the reefs cropping up from the ground, and there is reason to believe that very valuable gold mines are in existence, and could be worked and developed with little trouble. A Shan lately procured from here a piece of quartz 3½ lbs. in weight that produced exactly 2½ ticals of gold.

In the Yaw district, to the south-west of Mandalay, gold is obtained in fair quantities in the alluvial deposits; it exists at Sagaing, Kannee, Sein-joo, and is also obtained from the Kyeend-ween river, and, indeed, it is procurable from the sands of most of the streams between Mandalay and Mogoung. The natural conclusion from this profusion of gold in the rivers and streams of Upper Burmah is that it exists in large quantities *in situ* somewhere, and, as I have explained, this is the case, and doubtless there are more deposits that have not been discovered.

Silver is found in many localities in the Shan States to the east of the Irrawaddy river, but the most prolific mines are those situated at Bawyine, Kyouktch, and Toungbyne, near Theebaw, to the north-east of Mandalay. It is mixed with lead, and is in fact a rich argentiferous galena. One mine, the Kampanee, will yield as much as 40 ticals of silver and 25 viss of lead from one basket of the ore, while the poorest mine gives 4 ticals of silver and 30 viss of lead. Other mines exist, such as the Baudween, Baudweengyee, and Sagaing. The metal is also found in other towns unmixed with lead. The supply of silver obtained hitherto has been sufficient for the requirements of the country in conjunction with the imports from Yunan.

Copper.—This metal is found in the Shan States, but is not worked. It is also found at Kolen-myo and Sagaing; at Bawyine and Kolen-myo the malachite appears to be of a rich description. The copper resources of the Shan States do not appear to have been ever utilised to any extent, and the deposits, which seem to be abundant, remain as Nature placed them. The Sagaing mines were worked in former times by Chinese, but many years have elapsed now since they were abandoned. The surface ore is not promising. Most of the copper used in Upper Burmah is imported from China. It is plentiful in the province of Yunan.

Iron.—Iron abounds in the Shan States, and the district of Pagan, to the south of Mandalay, is noted for it. A manufactory exists on a rough-and-ready scale in this district at Pohpah Toung, but the out-turn is inconsiderable. To the west of Sagaing, for miles up the Irrawaddy river, the ore abounds—a rich hematite. His Majesty is now procuring iron-works from England, and will before long have a large foundry, with all the requisite machinery, erected and at work at Sagaing. The surface hematite alone will feed it for years to come, if worked. Two mining engineers are now awaiting the arrival of the works, and expect to proceed to Sagaing soon to commence operations.

Lead is found in abundance in the Shan States, and is extracted from galena. Considerable quantities of this metal could be obtained if such was desired. At present moderate supplies are procured, sufficient for the requirements of the land. It is also imported from Yunan.

Tin.—This metal exists in the Shan States to the south-east of Mandalay, but the mines have never been worked. The tin consumed in the country now is all imported.

Platinum is said to exist in the Shan States, and it seems probable that it does exist, but I have no reliable information on this point.

Graphite is found to the east of Nat-taik in large quantities on a low range of hills near the village Nyoke-toke. It is not utilised.

Coal.—This mineral is known to exist at Thingadaw, about 70 miles above Mandalay, on the western bank of the Irrawaddy; at Shuaygoo below Bhamo; at Meimbaloung in the Shan States east of Mandalay; to the south-west of Mandalay in the Yaw district, at Yaignaw, east of Nat-taik. It is found at Pagan and Shimpagah, and it is probable that it exists near Meuhla and Yeynangyoung. At Thingadaw the coal has been extracted, but it is of an inferior description, and more resembles lignite than the true mineral coal. An attempt was lately made here to ascertain the productiveness of the coal-beds. It is nearly certain that plenty of coal exists in the locality, and a few more borings would probably prove this. The coal-bed in the Shan States at Meimbaloung contains the true mineral coal, and consequently a valuable coal. It has been inspected by an experienced mining engineer, and highly approved of as equal to the best English coal. There is little doubt that the beds are extensive, but unfortunately the distance in land is great, and no easy means are available for transporting the coal to the low lands; indeed, the only method at present is by floating it down mountain-streams and rapids on rafts, which entails considerable risk and loss of coal. European skill and enterprise would soon make a safe route of one description or another if really required by the Government; it remains at present, with neighbouring wealth, where Nature placed it, awaiting development at times to come.

Jade and Amber.—The quality and extent of these mines above Mogoung is well known. They are both extensive and capable of development.

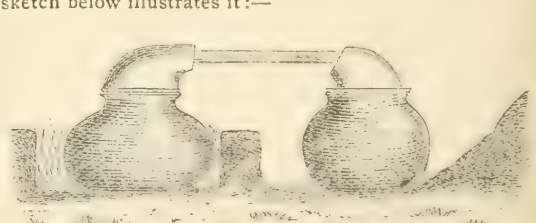
Sulphur.—This substance is not found in mass or in its native state in Upper Burmah, *sui generis*, but is found in efflorescent salts, and is manufactured from metallic sulphurets. The following is a list of localities where it is made, and the yearly average out-turn:—

	Viss.
Mooda Myo, N.	3000
Tsein-goon, E.S.E.	2000
Kyouk-hoo, S.E.	3000
Bawyine, Shan States, S.E.	6000
Dybayen Myo, N.W.	4000
Pagan Myo, west bank of the Irrawaddy..	4000
Toungthoo Einlay, E.S.E.	4000
From the Bhamo district	2000
Total viss yearly ..	28,000

At Toungthoo Einlay, to the south-east of Mandalay, sulphur is manufactured by the Toungthoo Shans, who sell their out-turn to the King; at all the other places the mines are worked by His Majesty.

The Bawyine works have been increased during the past month by four extra furnaces, which will give about 5000 viss more per annum. The sulphur ore appears to abound in the Shan States; in fact, at Bawyine, Kyouktah, Dybayen, Pagan, and Toungthoo Einlay, the supply seems to be unlimited. It is found in the tertiary blue clay from 12 to 20 feet below the surface, which is an alluvial deposit of the old red sandstone; it is embedded in the clay, and consists of very hard metallic pyrites of some size.

The mode of extracting the sulphur is very simple. The sketch below illustrates it:—



Common chatty-shaped vessels are made on the spot from the soft blue clay in which the ore is found. The larger vessel is filled with broken ore, and placed on a fire, a clay retort being fitted to the top, and communicating

with the smaller vessel. The sulphur is thus sublimed and condensed as shown, after which the retort is broken, and a hollow tube of flower of sulphur extracted therefrom which is superior to that condensed in the vessel. Iron pyrites do not appear to be utilised in the manufacture of sulphur, and it is doubtful whether the Burmese could utilise them. These pyrites are to be found in abundance in parts of Upper Burmah and the Shan States. The imports from Yunan are also considerable every year.

It is manufactured in Yunan, and in the "Shit-Pyee-Doung," or eight Shan States to the north-east of Bhamo, at present under the rule of the Chinese, or tantamount to the same. European sulphur can be purchased in the bazars at the rate of Rs. 3 per viss.

Saltpetre is manufactured at the following places in Upper Burmah :—

1. Toungthoo Einlay.
2. Ameerapoora.
3. Shimpagah.
4. Ong-ben-lay.
5. Leen-gine.
6. Sameet-koon.
7. Pyogan.
8. Aung-gyeen.
9. Samoon-gyee.
10. Oo-yun-galay.
11. Shuaybo.
12. Satoung-ma.
13. Salem-myo.
14. Yoon-doo.
15. Myo-tha.
16. Tsit-kine.
17. Aloon.
18. Tee-ber-Yeen.
19. Myay-Yeen.
20. Shin-bin-oon-Eni.
21. Yua-shit-gyee.
22. Enidyne Yuo (Kyouk-say, S.E.).
23. East of Pagan (Yoong-daw Toung).

The yearly average out-turn is about 40,000 viss. The manufacture is not prohibited as with sulphur, and considerable quantities are used in the preparation of fire-works.

The manufactures at Toungthoo Einlay, Eindyne, Kyouksay, Yoongdaw Toung, and Sameet-koon can produce very largely if required.

At Toungthoo Einlay the Toungthoo Shans in former times used to make from 20,000 to 25,000 viss of saltpetre per annum, but emigration to British territory has considerably reduced this.

The price of saltpetre is Rs. 50 per 100 viss. Many parts of Upper Burmah are well suited for its manufacture, the ground being well supplied with nitre.

Rubies, Sapphires, Garnets, &c.—These are found in abundance at Mogouk, Kyat-pyeen, to the north-east of Mandalay near Momeit. The ruby ground extends over a large area of hilly country. The gem sand is found from 3 to 15 feet below the surface soil, and the beds are then followed up. The method of working is primitive and rough, the consequence being that large rubies are seldom extracted intact.

Some years ago, a Mr. Bredamajee, a German mineralogist, was located at these mines for the purpose of developing them, but, after a short stay, he got into trouble with the people, and was dismissed.

He declared that, with careful working, rubies as large as pigeon's eggs could be extracted, and that the mines were very rich. At Mogoung, also, ruby mines exist, and very fair rubies have been found. The Sagyeen or marble hills, a short distance to the north of Mandalay, contain the gems as well, but they are of too light a colour to be valuable ; they are, however, mixed with other rubies and disposed of.

Salt.—Extensive salt-fields exist at Shimpagah, a short distance above Mandalay, on the western bank of the Irrawaddy river. It is also obtained at other places in Upper Burmah on a small scale. Large quantities can be manufactured at Shimpagah, but imported salt is fast taking its place in the market. The hill people, though, appreciate to a certain extent the Shimpagah salt, and mix it with European salt.

Petroleum.—This mineral oil is found at Yegnangyoung and Pagan, but information regarding it is so complete that it is hardly necessary to allude to it further. I will, however, make a few brief remarks. There are at present about 150 wells worked at Yegnangyoung; the quantity of oil estimated as deliverable from these wells is 15,000 viss daily, of which 10,000 viss is taken by the contractor who supplies British Burmah, and 5000 viss by the contractor who supplies Upper Burmah. The total yield of these wells is 6,000,000 viss per annum, or 9375 tons. There are many abandoned wells, and wells that produce very small quantities of oil. At Pagan there are about 50 wells ; they yield daily 1500 viss of oil, which the earth-oil contractors, at present the Lay-myo-woon and one Moung Tsanwah, are allowed to purchase. The oil from these wells is obtained in a more liquid state, and more resembles naphtha. It is of a brackish nature, and is better suited for lighting purposes than the Yegnang-young oil. The total supply of earth-oil in Upper Burmah now per annum is 6,600,000 viss, or 10,312½ tons.

I have omitted to mention marble and limestone, but both abound.

Upper Burmah, with its metals and minerals, its forests, natural resources, productiveness of soil, and from its geographical position, situated as it is close to the teeming population of the Chinese empire, ought to be the richest country in Asia, and Rangoon one of the largest emporiums of trade. The productiveness of the soil, as regards cereals and other crops, is wonderful. The indigo plant, which is prolific in its growth, gives three crops per annum, and the dye would quite equal that of Bengal with careful and proper treatment in its manufacture. Paddy, wheat, cotton, cutch, grain, sesamum, sugar-cane, tobacco, tea, coffee, each has its own soil in abundance.

Teak and other useful trees abound, and, taking all in all, Upper Burmah would seem to have a grand future in store for it, as civilisation advances and old prejudices give way to new and enlightened ideas.

A few remarks on india-rubber or caoutchouc may be of some interest.

The estimated number of trees, which are chiefly situated in the Bhamo and Mogoung districts, is 400,000. They thrive best in damp moist soil, and in thick forests, shady and cool. The trees attain to a height of from 50 to 100 cubits, being from 15 to 20 cubits in girth at the base (full-grown trees), and with roots creeping over the ground for some distance. They are fit for tapping when from six to ten years of age, at which time they are from 15 to 20 cubits in height and 3 cubits in girth.

When the time for tapping arrives, incisions are made in the trunks of the trees and in the roots above ground. Hollow bamboo cups, about 1½ feet in length, sloped and pointed similar to a prepared pen, are then inserted in the incisions, and receive the oozing juice or milk. Three- or four-hundred of these bamboo receptacles are inserted in each tree. The tapping is continued for about a month, after which time it is discontinued, and the wounds allowed to heal. At the expiration of another month the trees have regained strength, and tapping is re-commenced.

In preparing the india-rubber, the following crude method is observed :—Water is boiled in large iron pans, and the juice of the tree is thrown in, when it gradually thickens, and subsequently is dried. The india-rubber so obtained is being brought into local use for covering water-buckets, baskets, and boxes as a substitute for dammer.

The existence of the india-rubber tree in Upper Burmah does not appear to have been known, or, at any rate, it did not attract attention, until somewhat recently, when three Europeans, Messrs. Miller, Marshall, and Henri, who were employed at the jade stone mines, were forced to look and search about in the forests for a substance that would effectually repair a diving apparatus that they used in working for jade stone. They found india-rubber, and repaired the apparatus. The existence and value of the juice was then brought to the notice of the King, and Mr. Henri is now employed in tapping the trees and preparing the juice. Some 70,000 viss of india-rubber was brought from Mogoung last year. I myself saw thirty or

forty cart-loads of it entering the palace one day. Upper Burmah could produce 200 or 300 tons of this useful substance per annum.

January 22, 1873.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 178).

THERE are other substances on which this same law, determining the rate at which the affinities are to operate, may be impressed. Gun-cotton is one. We are again obliged to Mr. Abel for two illustrations on the wall showing the destruction of the martello tower at Dimchurch, in Sussex. It was accomplished with 186 lbs. of compressed gun-cotton. And the development of the affinities was such that the tower changed at once into the form you see in the second diagram. Had gun-cotton in the same state of combination and of the same character been put into a cannon, in all probability the cannon would have burst before the ball had time to move.

Some very peculiar and inexplicable affinities are presented by this ally or rival of gunpowder, viz., gun-cotton. In the first place, the rate of combustion and the consequences of it may be previously regulated, and that with much accuracy. Its energy may be mild or great, at the will of the operator. The results of numerous experiments is, that to obtain the full power of gun-cotton it must be exploded in a close chamber, in order that the gases and heat generated by the first part of the explosion may penetrate the mass. The records of experiments with gun-cotton show very plainly the absolute necessity for considering how affinities comport themselves. A bag of gunpowder nailed on the gates of a city would blow them open; a bag of gun-cotton so nailed would fail. Put the gun-cotton in a box, and it will shatter the gate to atoms. A box of gun-cotton flung down close to palisades would open a passage for troops.

Spectrum analysis reveals the fact that the spectrum from the flame of a compound body, as chloride of calcium, is not the same as that observed in the electric spark passing over pieces of chloride of calcium. The explanation suggested is that certain chemical compounds, when they are heated above a given temperature, are decomposed into their constituent elements below that temperature. These compounds are capable of existing in a permanent state. It may be thus with the energy of gun-cotton. When discharged at the temperature of flame, the gaseous constituent elements are not formed, and therefore no explosion. When at the higher temperature producing concussion, then the constituents are formed, and explosion ensues.

You will find that the rate at which gun-cotton explodes depends upon the rate at which the affinities are called into play. Here is a specimen. If we bring the affinities of this gun-cotton into play by means of a spark, and thereby do not produce sufficient heat to develope its affinities rapidly, the rate at which the gun-cotton is consumed is comparatively slow. If we bring its affinities into a flame, the rate at which affinities are developed in consequence of the heat is great. If we bring them into play by means of detonation, the rate at which they are developed is greater still. You see that when a flame is applied to this strip of gun-cotton it runs along it rapidly, whereas when a spark is applied to a piece of the same material the combustion is slow, like touch-paper. If I hold up the string of spark-ignited gun-cotton, the heat gathers, the ignition becomes more rapid, the spark being converted into a flame. Now if instead of allowing the affinities to be exercised at that slow rate we cause them to develope immediately, we should have had a very different result. Here is some pulp gun-cotton, the very form in which it was used for the destruction of this tower. If we detonated some of that, we should none of us be here to tell the tale of how it went off. There is enough in my hand to send the walls of this room in all directions, but it must be by detonation. The effect of what is something like detonation can be shown in a different form. You are aware that in a coal-mine there are fearful explosions. It has been found that these explosions often take place after a blast in a distant part of the mine. The question therefore is, what has that blast to do with the explosion, the two not being near together? Mr. Galloway, of the Meteorological Office, has been investigating this matter for some time past, and it has been found that these Davy safety-lamps, of which specimens are on the table, are not, when within the influence of a reverberation of the air from the effects of a blast in a distant part of the mine, always as safe as they are supposed to be.

The lamp consists of a flame within gauze; and when surrounded by an explosive compound, owing to the inability of the flame to penetrate the gauze, the explosive gas does not ignite. If, however, detonation takes place, even at a distance from the lamp, then we shall produce those conditions which are favourable to the development of chemical affinity. Here is a Davy safety-lamp, lighted, and now placed in an atmosphere of explosive gas. The question is, what will happen in case a shot is fired in a distant part of the mine? In the case before you the lamp is placed at one end of a long tube, the other end of which is closed by a piece of india-rubber, and in continuation of, but detached from, the long tube there is a short tube of the same diameter. There is no communication whatever between the two tubes, and, as you may notice, there is a space between the ends of them. My intention is to fire a pistol at the open end of the short tube; the explosion will cause the india-rubber to be compressed, and so to act on the air in the longer tube. You probably know that if there were on the table a box with an elastic back, and a candle at the other end of the room, opposite to a hole in the front of the box, then by striking the box at the back the candle would be blown out. Now, on firing the pistol, having its end in this short tube, the india-rubber is compressed, and the gas surrounding the Davy lamp, which is supposed to be in a distant part of the mine, at once bursts into flame. This is the same phenomenon that takes place when shots are fired in one part of a mine, and an explosion occurs in another part.

This is all well and good if it would help towards a solution of the question of regulation of the energies of these affinities, if only we could delay the affinities as we delay them in gunpowder, because we might then do what Galileo did when he delayed the ball down an inclined plane; or what Kater did when he caused the pendulum to repeat itself frequently, and so record the effects of gravity; or what Atwood did when he took a small weight and caused that to fall by gravity, but distributed its effect through a large mass. The consequence was that they were enabled to observe what the law of gravity is. If, now, we could rely upon such a process of delaying the affinities as has now been mentioned, we should then have a chance of ascertaining their energies; but we cannot rely upon it, for two reasons. In the first place, there are a number of phenomena classed under the head of nascent actions, which constantly interfere. Let me explain what that is. At the time that certain substances are being formed, certain affinities exist which do not exist afterwards. If, for example, you manufacture hydrogen and then bring nitrogen, from another process of manufacture, into contact, they do not combine. If, however, you manufacture them both in the same vessel, they combine and form ammonia; and hence, in the case of putrefying vegetables, there arises that peculiar

* The Cantor Lectures, delivered before the Society of Arts.

ammoniacal smell. Here is some permanganate of potash, which, when dropped into this tube of coloured liquid, will produce certain phenomena, which take place owing to this nascent action—the colour will be discharged.

Then there are another set of actions which are more peculiar still, which manifest great energy, but which actions interfere with our measuring the energy of affinity as utilised by men. We have here a piece of platinum, and here is an argand burner, connected by a flexible tube with the gas-pipes of the room. Over the argand burner is placed this copper cylinder on three legs, having a wire gauze top. The sheet platinum is now coiled and placed on its edge on the gauze. The tap is opened, and the gas now burns with a lambent blue flame. Observe, the platinum is now being heated; now it glows. Let the gas be turned off. The flame is now extinguished; the once glowing platinum has become black. Thus far is nothing peculiar. Again, the gas is turned on. The black platinum is passing to a dull red; now it glows again, but the gas is not ignited, and the platinum remains at this red-white heat without any apparent cause. If a glass cylinder, to protect it from currents of air, be placed round it, this apparent burning without being consumed will continue during the remainder of the lecture, and, were conjuring tricks an object, it might be said that light and heat were here produced without the destruction of any materials. This is a case of what is called catalytic action. Phenomena like these perplex very much in estimating the energy of affinities.

Here is another case, of a like peculiar character. This is a coil of platinum wire, and you will find that if made red-hot, and then placed in a vessel of ammonia, although there is no gas in it, the platinum continues red-hot. There is no reason, apparently, why it should continue in that red-hot state.

(To be continued.)

CORRESPONDENCE.

THE LATE MR. CHAPMAN.

To the Editor of the Chemical News.

SIR,—That the splendid chemical work with which the late Mr. Chapman has enriched science was carried out in the laboratory over which I presided is almost as well known as the work itself, and most chemists will be surprised to read a biography of that distinguished chemist which describes his having been at school in Heidelberg and attended the lectures of Bunsen and Delffs, and his having studied in the laboratories of Hofmann, Frankland, and Kolbe, but omits all mention of his ever having worked in my own laboratory. Such a biographical curiosity, which may be seen in the last number of the *Journal* issued by the Chemical Society, affords an apt illustration of the real objects which are aimed at by the official body in charge of the Society, and is a worthy sequel to the refusal of the Society to publish one of Mr. Chapman's best pieces of work.—I am, &c.,

J. ALFRED WANKLYN.

Oct. 2, 1873.

MISCELLANEOUS.

Analysis of Milk.—A work by Mr. J. Alfred Wanklyn is in the press, entitled "Milk-Analysis;" it will, we understand, be published in a few days.

Society for the Promotion of Scientific Industry.—In a former number of the CHEMICAL NEWS was advocated the establishment of a Society of Manufacturing Chemists. But the manufacturers and promoters of scientific industry of Manchester have gone beyond the proposed limits, and have established the Society whose title heads this paragraph; they have not confined themselves to the science of chemistry alone, but extend help and assistance to all. The Society is in its earlier stages, but its success would seem to be certain. Founded on the principles of the celebrated Société Industrielle de Mulhouse, its object is the increase of the technical knowledge and skill of those engaged in the various industries; the improvement and advancement of manufactures and the industrial arts and sciences; and the general progress, extension, and well-being of industry and trade. This multiple object the Society seeks to attain by the encouragement of investigations and experimental researches in science and the arts, having a practical bearing upon industry; by the offer of premiums and rewards for the invention of new or the improvement of existing processes or products, and for the discovery of new raw materials, and for their application and use; by the reading and discussion of papers and essays of practical interest affecting industry; by the publication and circulation of such papers and essays, with the discussions upon them; by the formation of a library and museum of industry; by the holding of exhibitions; by having agents at the several seats of foreign industry, specially charged to report on all matters appertaining to the work of the Society; and by delivery of a course of technical lectures. The first series of these lectures will be upon the great staple industry of cotton. Amongst the papers to be read and discussed in the ensuing session, the first are:—"On the Economy of Fuel," by T. Prideaux, Esq.; "The Manufacture of Sulphuric Acid," by Frank Spence, Esq.; "The Law and Practice relating to the Protection of Inventions, with some observations upon the Patent Office Museum," by W. Lloyd Wise, Esq.; "The Mechanical Appliances used in Calico Printing," by W. Mather. The work done by the Society includes the sending out of thirty skilled workmen to Vienna to report upon the various great industries shown in the International Exhibition; the arrangements for forthcoming exhibitions in "textile fabrics" and in "fuel economisers." The Society is proposed to be supported by subscriptions and donations. The first year's subscription for a fellowship of the Society is three guineas, one-third of which will be funded; the second and subsequent years' subscriptions will be limited to two guineas. Manchester has the credit of the first step in such an important movement amongst scientific industries. Of the result, it was predicted in our former article that benefit, more or less, must ensue. From such principles, carried out with so much energy and vigour, the most brilliant prospects are a necessary sequence. There are certain subjects of human knowledge and enterprise whose difficulties always succumb to well-directed energy, and scientific industry has hitherto appeared no exception. The volume of Artizans' Reports upon the Vienna Exhibition, published by the Society for the Promotion of Scientific Industry, Manchester, will be published about the 20th of this month. There are thirty-six reports, which are said to be of a very high-class character.

NOTES AND QUERIES.

Gilding.—Will any of your readers tell me how to remove a firm black coating from the surface of gilt on cast copper? A year ago I fixed a cast copper ornament, heavily gilded, out of doors in a clear country atmosphere, and, though ordered to be, and supplied as, weather-proof, it turned colour after first fall of snow, and in three months was black, with what appears to me to have risen through the gilding. It sticks close, and rubbing with cloth and spirits of wine scarcely affects it. Can it be removed by any solvent without affecting the gold, and, if removed, is the same "blacking" liable to recur?—STAR.

Notes on the Utilisation of Sewage.—(From the "Report of the Main Drainage Committee for 1864," vol. 487).

827. (To Mr. Hope.) Then the cost of that has to be added to the 6s. referred to, has it not?—Quite so. Professor Way, in his evidence before the Select Committee of the House of Lords on Town Sewage, put it very clearly, I think, in his answer to question 744. He says: "If you gave me dried sewage, it would be capital manure to any crops, no matter whether wheat or green crops or grass; it is merely the

form in which you present it that makes it unsuitable for some crops. It strikes me that it is the same kind of thing as if a man were to owe me the value of an ounce of gold, and were to bring it to me in the shape of gold quartz, saying: 'Here is so much gold quartz, which contains £4 15s. worth of gold,' or whatever it may be. That would not be paying me at all; I should have to take it with all its disadvantages, and to get it out of the quartz.

1075. (To the same.) Would it be very costly to pump the sewage up into some reservoir on a height, so as to allow it to gravitate all over the country?—No, that is not a costly operation; Cornish engines can be employed, and are employed, to lift enormous quantities of water at very little cost.

1077. (To the same.) Have you made any calculations as to what the cost of the pumping would be?—No, I have not; but I know it is the fact that enormous quantities of water can be pumped to a great height at an almost incredibly small cost.

1118. (To Mr. Moore.) What amount of horse-power do you imagine that the Metropolitan Board of Works would have to use in order to lift the 80,000,000 gallons of sewage 200 feet during the ten working hours of the day?—I have made that calculation, but I have it not with me.

1119. (To the same.) How would you make that calculation?—One horse-power is equal to 33,000 lbs. lifted a foot in a certain time; that is the mode of calculation.

1120. (To the same.) That would be upwards of 8000 horse-power net, would it not?—I suppose it would require that.

1121. (To the same.) And it would be about 15,454·5 gross horse-power?—I do not think it would require that for the height.

1122. (To the same). If it is 8242·4 horse-power net, how much gross horse-power would it be?—That would depend upon the difference for friction.

1127. (To the same.) You offer the Board of Works a farthing a ton for the sewage, do you not?—Yes, which they would raise with a power equal to 200 feet.

1128. (To the same). And do you estimate that 136,000 annually?—The half of that would be a profit to them, because it would not cost them one-eighth of a penny per ton to lift it.

1136. (To the same.) How much of the sewage would cultivated land take?—That would depend on the state that the land was in. A market gardener at present manures at the rate of £20 an acre with solid manure.

1137. (To the same.) And you propose to deliver the sewage at a certain price to him?—Yes.

1138. (To the same.) Do you fix any price as the basis of your calculation?—The price to the whole of the consumers is a penny per ton. I do not think that it would answer any farmer's purpose to pay more than that.

1139. (To the same. How many tons to an acre would you put on irrigated land?—From 4000 to 5000 an acre; that would be about £20 an acre.

1274. (To Mr. Smith.) And what would be the working expenses of your sewage-works, pumping, and so forth?—The sewage-works to lift the sewage proper would cost about 1-12th of a penny per ton of sewage; that is, for coals, labour, and oil, exclusive of the plant.

1310. (To Sir Charles Fox.) Do you propose to pump by steam?—Yes.

1311. (To the same.) What would be the horse-power that you would require?—3,500 nominal horse-power.

1312. (To the same.) Do you assume the sewage to be 80,000,000 gallons daily?—Yes.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in apparatus used in the manufacture of salt. J. Bowden, accountant, St. Mary's Road, Canonbury. February 3, 1873.—No. 399. The features of novelty of this invention consist—First, in arranging the heat flues of salt-pans in a zigzag winding or circuitous direction, instead of the said flues passing direct from the fires to the chimney as heretofore generally practised, and by these means to utilise the heat that is now lost, and thereby economise the consumption of fuel; secondly, in surrounding salt-pans with some substance or material which is a non-conductor of heat to prevent loss of heat by radiation, also in adapting a cover to the pan to protect it from rain or cold air; thirdly, the formation of a brine-tank immediately above the salt-pan through which the flues in a series of tubes or passages shall pass; the said tubes or passages coming immediately in contact with the brine in the tank will impart to it its heat, and thus increase the temperature of the brine.

Improvements in the manufacture of tin-foil, and in the covering of other metals with tin, also in the machinery or apparatus employed therein. J. H. Johnson, 47, Lincoln's Inn Fields, Middlesex. (A communication from Jean Baptiste Ferdinand Masson, Paris.) February 3, 1873.—No. 406. This invention relates to a peculiar process of and apparatus for manufacturing at one and the same time and in one apparatus, two sheets of tin-foil of any desired thickness, or of coating, if desired, a plate or sheet of lead or other metal with tin by allowing the molten tin to adhere to the sides of a prepared surface which is drawn up vertically through the bath of tin, being divided for that purpose. If a sheet of scoured metal be so drawn up, the tin will adhere permanently thereto and thus coat it.

Improvements in extracting animal grease and other impurities from wool. T. W. Dunn and O. Prangely, both of Trowbridge, Wilts. February 5, 1873.—No. 420.—Wool in its raw state is placed into a chamber into which steam is admitted, and is then pressed.

Improvements in the treatment and use of air for the manufacture of gas for lighting and heating purposes, and in the apparatus employed therein. C. W. Harrison, High Holborn, Middlesex. February 5, 1873.—No. 435. This specification describes a method of oxygenising air by passing it under pressure or otherwise through water or any other suitable liquid that will absorb a larger proportion of the oxygen of the air than of the nitrogen. The air thus oxygenised is recovered from the water by a pump or other suitable means and stored for use in a holder, whence it is conveyed by pipes to where required for use, and is then passed through a suitable hydrocarbon, and thus converted into inflammable gas or vapour adapted to lighting and heating purposes.

Improvements in the manufacture of explosive compounds, and in the apparatus used in such manufacture. S. J. Mackie, 3, Delahay Street, Great George Street, Westminster. February 6, 1873.—No. 445. This provisional specification describes apparatus for steeping cotton-pulp or waste in an acid bath, placing it in digesting pots, and removing the pots in a cradle by a crane to the cooling pond. Freeing gun-cotton from acid by passing it through rollers. Apparatus for ascertaining the amount of dry gun-cotton in a mass of wet material. Apparatus for granulating compound of cotton gunpowder. Apparatus for giving any desired density to granules of cotton gunpowder.

THE
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Notices of Books. Progress of the Various Sciences, &c., &c.

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SUPPLEMENT
TO
THE CHEMICAL NEWS.
VOL. XXVIII. No. 724.

NOTICES OF BOOKS.

Quantitative Chemical Analysis. By T. E. THORPE, Ph.D., F.R.S.E., Professor of Chemistry, Andersonian Institution, Glasgow. London: Longmans, Green, and Co.

We have had occasion to notice the increasing supply of elementary chemical works which have latterly been issued in the British Islands. It may be—as we should be glad to find—that this increase is due to an augmented demand for chemical knowledge; that our delightful science is more and more forming a constituent part of a liberal education, and that those who devote themselves to chemistry as a profession are increasing in number and in public appreciation. Or it may, perhaps, be due to the fact that a smattering of science is fashionable, as it was in the days of Charles II.

The work before us is, however, if fairly used, not calculated to further the production of that very objectionable animal—the smatterer. Thoroughness has evidently been the author's object, and he has been far from unsuccessful in its attainment. If we turn to any of the examples we find the method of procedure clearly and fully described, the needful precautions indicated, and the possibility of failure as far as practicable cut off.

The author uses the most modern nomenclature, and it may be that his work, arranged as it professes to be for the use of artisans, will contribute something to familiarise practical men with this system. At present the "capriciousness of chemical terminology" is not without reason felt to be a grievance of no small magnitude. The question is very generally asked whether the benefits derived from the new nomenclature do more than counterbalance the confusion it has occasioned, and the additional difficulties in the acquisition of chemical knowledge which it has created.

The student who has carefully worked through the examples given in this volume, attending strictly to the instructions given, will be on the high road to becoming an expert and accurate analyst.

The subject of water analysis—no unimportant one in these days of rivers' pollution investigations, and mythological "previous sewage contamination"—is treated, as the preface announces, in considerable detail. We cannot help questioning the policy of attempting to instruct artisans in a process which chemists of the highest standing have after careful trial abandoned as fallacious, because—setting for the moment all other objections aside—the amount to be determined falls within the limits of error of a carefully and skilfully conducted combustion.

In conclusion, we can only pronounce this work a valuable addition to English chemical literature, and congratulate the Andersonian Institution on the style of instruction which evidently prevails in its laboratory.

Sewage: Suggestions for its Utilisation, having special regard to Sanitary Requirements. London; E. and F. Spon.

No better proof can be given of the difficulties besetting the utilisation of sewage than the number of treatises and pamphlets in which the question is discussed. Each author thinks that he has come upon the one essential point which all his predecessors have overlooked. Unfortunately the problem has not been examined with the calm impartiality befitting men of science grappling with a great national evil. There has arisen an *odium cloacinum* even more rancorous than the well-known *odium theologicum*. The plainest facts have been overlooked or distorted; the strangest inferences drawn; and "recommendations" the wildest and most impracticable have been issued on high authority.

The recent outbreak of typhoid fever in Marylebone has called general attention to a source of danger suspected, indeed, long ago by a few judicious men, but disregarded by the press, the public, and by officialism. Let it be granted that cholera, fever, or other zymotic disease exists in a certain town. The germs of such disease must evidently find their way into the sewers; here they will not, under ordinary circumstances, meet with any agency capable of effecting their destruction. If, now, the sewage is applied, *untreated*, to the land, as in ordinary irrigation farms, these germs must be diffused over the fields. They may adhere to the surfaces of plants, and perhaps may even be absorbed into their capillary vessels. In either case there is no natural process at work by which their vitality is likely to be extinguished. They may thus be taken directly into the human system along with vegetables and fruits that are eaten uncooked; or they may be swallowed by cattle along with turnips, cabbages, Italian rye-grass, &c. Here, again, in the bodies of the cattle they are not, to the best of our knowledge, liable to be destroyed. According to certain recent researches, living *bacteria* are found in milk as it issues from the udders of female animals, and determine therein the formation of a small amount of alcohol. Such being the case, there is no *à priori* absurdity in the hypothesis that the milk of cattle which have drunk water contaminated with cess-pool matters, or, still more, which have been fed on herbage grown on a sewage-farm, may convey the germs of disease into the systems of human beings. This, it must he remembered, is not one of the cases where the benefit of a doubt can be given to the defendant. If a ship arrives from a port where pestilence is raging, the crew and passengers are placed in quarantine, not because they *have*, but because they merely *may have* about them the germs of the infection. Letters have appeared, indeed, asserting that in such and such quarters the milk from a sewage farm has not occasioned fever. This reminds us of the thief who, when confronted with several witnesses that had seen him stealing a horse, offered to produce as many more who had not seen him. We could lay our finger on certain districts in the eastern counties especially, where the inhabitants derive their supply of water for domestic consumption from road-ditches and duck-ponds, into which the drainage of richly-manured fields and of farm-yards fall, and which stand in indisputable connection with half the cess-pools in the village. Yet in these localities the mortality may be about 15 in the 1000, and the natives may live to the proverbial "age of a crow." Yet we cannot, on the strength of such cases, venture to assert that polluted waters are harmless and that their general use might be permitted with safety. Precisely similar is the case with the use of untreated sewage.

The pamphlet before us points out a way in which this particular danger may be obviated; and thus *one* at least of the many and formidable objections to the scheme of sewage irrigation may be removed. This has been done at Carlisle. The sewage of that town, before being allowed to flow upon the land, is mixed with carbolic acid, carbolate of lime, and sulphite of magnesia, as patented by Messrs. MacDougall. The disinfection is remarkably complete. No one who has visited the Carlisle farm complains of the "truly mephitic odours," such as the Prussian Commissioner, Lefeldt, laments at Romford, and such as everyone finds at Croydon. The crops, as stated in the pamphlet before us, are:—"Quite free from the rankness and liability to rot of all crops grown on sewage land where the antiseptic treatment is not adopted." Again: "It is also worthy of remark that,

whereas at other sewage farms parasites in the herbage are so abundant that many stock-owners object to pasture their animals on the irrigated meadows, the ravages of the parasites producing liver-rot and foot-rot being so greatly accelerated by the decomposing deposit on the land, at Carlisle the animals have been unusually free from these diseases." These statements are fully confirmed by information which we derive from other quarters. The stems of the grass grown on the Carlisle irrigation farm are not found filled to the height of some inches with unassimilated sewage-matter, nor do cattle, warned by their instincts, turn away from it with disgust. Neither, again, is the land watered with disinfected sewage haunted with those legions of flies and other noxious diptera which, in the vicinage of certain irrigation farms, constitute a perfect Egyptian plague, and which, first sucking up putrescent matters from the damp soil, and then biting the faces of the inhabitants, may at any moment transfer to them the infection of carbuncle, of ophthalmic, and of many other formidable diseases.

The expense of purifying sewage by this method is stated at one penny per thousand gallons, or £4 11s. 8d. per million. Thus, a town turning out 10,000,000 gallons of sewage daily, and disposed to adopt the irrigation principle, would incur for the disinfecting material an additional expense of, in round numbers, £1612 yearly. Against this would have to be set the superior quality of the produce raised, and the saving of stock which would otherwise perish from parasitical and entozoic disease. If sewage irrigation is to be tolerated at all—a point which, in our humble opinion, is by no means decided—it must be on the express condition of preliminary disinfection with the preparation recommended in this pamphlet, or with something analogous in its mode of action.

Our author appears, however, to have overlooked the obvious fact that carbolic acid preparations are by no means exclusively linked to irrigation. They may be, and actually have been, used with great advantage as adjuncts to other methods of treating sewage. When judiciously applied, they extinguish the life of germs and ova in sewage manures as well as in the effluent water. At the same time, unlike certain other disinfectants, they have in the proportions employed no injurious action upon plant life. Messrs. MacDougall were, we believe, the first to draw public attention to the germ-destroying power of the coal-tar products, and by so doing they commenced a new era in sanitary science.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, September 8, 1873.

Fifth Note on Guano.—M. E. Chevreul.—The crystalline matter mentioned in the author's first note is, he believes, a neutral oxalate of ammonia. A fresh sample of gauno, of a dull brown colour, and suspected of having been moistened, presented a curious fact. 100 grms. having been five times washed, each time with 100 grms. of water, and thrice more with 200 grms. of water each time, still gave an alkaline reaction. This phenomenon M. Chevreul ascribes to capillary attraction; a force which he supposes to play an important part in agriculture, as regards soils and manures. In the aqueous extract he suspects the presence of one or more volatile and odoriferous acids, independent of avic acid. The bones of birds found mixed with the guano are reduced into irregular fragments, angular rather than rounded, of a brownish orange colour. These fragments have no cohesion, and if rubbed with a glass rod in a platinum capsule with a little water they are reduced to orange coloured flakes. The water becomes coloured, and on concentration it is found distinctly acid, and holds in solution an appreciable quantity of phosphate of lime.

Pyrogallol in Presence of Salts of Iron.—M. E. Jacquemin.—According to the author's experiments, ferrous sulphate never takes a permanent blue colour with pyrogallol except when it is partially peroxidised, as is shown by its being reddened by the alkaline sulphocyanides. Of the two he considers pyrogallol the more sensitive reagent for traces of ferric salts. In ferroso-ferric salts the blue colour turns first greenish and then red: 2 per cent of ferric salt is sufficient to produce this change in a few minutes. These red liquors become gradually turbid, and the next day a deposit of purpurogalline may be separated by filtration. The filtrate on standing grows turbid again, and the second day a mixture of purpuro-galline and tanno-melanate of iron may be filtered off, but on the third day the tanno-melanate alone is formed. After the separation of the purpuro-galline traces of ammonia produce a deep blue-black, which becomes a fine purple-blue on dilution. If the quantity of ammonia is gradually increased the colour produced becomes a violet resembling that of anilin, an amethyst-violet, and a red. With syrupy perchloride of iron a concentrated solution of pyrogallol turns brown. If the solutions are dilute the blue colouration passes rapidly to red. The red obtained by the addition of an excess of ammonia is turned blue by acetic acid, and reddened again by an alkali. The author has likewise studied the behaviour of pyrogallol with ferric cyanide.

Reflections on Spontaneous Generation, in connection with a note by M. U. Gayon "On the Spontaneous Alteration of Eggs," and a note by Dr. Crace Calvert "On the power of Certain Substances to Prevent the Development of Protoplasmic Life."—A Béchamp.—The author states that there are at least three distinct albumenoid matters in the white of eggs; in the yolk, besides the microzymas insoluble in water, there are two bodies soluble in that liquid. He maintains that albumen, gelatin, infusion of yeast, with or without sugar, may be preserved easily in free contact with air. Urine and blood are easily preserved by creosote or phenol. Blood is one of the liquids where bacteria appear the least readily.

Researches on Crystalline Dissociation (continued); **Evaluation and Distribution of Work in Saline Solutions.**—MM. Favre and Valson.—When a salt is dissolved in water there is a contraction of the total volume of salt and solvent. But contraction can be produced in water differently, and without a salt, viz., by lowering the temperature. If we measure the number of calories yielded corresponding to a determinate contraction of water, we can estimate the corresponding mechanical work. In accordance with the mechanical theory of heat, if we measure the contractions of volume accompanying saline solutions we have a measure of the coercitive action of the salt on the water. This is the principle of the author's work. Having previously studied the solution of sulphate of soda (anhydrous and hydrate) on water, they here similarly study that of a number of other salts. They first determined the densities of normal solutions, or those containing uniformly 1 equivalent of the anhydrous salt (estimated in grms.) dissolved in 1 litre of water; and the densities of the salts. A table gives the densities of the salts considered in the anhydrous and in the hydrated states, and in the state of normal solution. It was

formerly found that a contraction of 1 c.c. in 1 litre of water at a temperature of 15° was equivalent to a liberation of 7576 calories; and that, conversely, this number of calories measures the work necessary to compress and diminish the volume of 1 litre of water 1 c.c. at that temperature. Hence, to obtain in calories the thermic effects corresponding to different contractions a, b $(a-b)$, we have only to multiply these contractions by the constant number 7576. The numbers for the various salts are tabulated; and a third table gives the quantities of heat liberated or absorbed in the act of solution. It appears—(1) That the salts range in the following order of increasing contraction:—Borates, carbonates, sulphates, chlorides, acetates, bromides, iodides; (2) the contraction produced by solution of an anhydrous salt is greater than that of the same salt hydrated; (3) the contraction from solution of a hydrated salt is generally less than that produced in the formation of crystals; (4) the number of calories measuring the effects of contraction is much higher than the number of calories shown by the calorimeter; (5) the calories shown by the calorimeter have to be added or subtracted, according to their signs, from the calories deduced from contraction. As example of the second case, carbonate of soda (anhydrous) gives in dissolving a contraction of 21 c.c. corresponding to 15,096 calories, but there are 3658 calories set free, and shown by the calorimeter; the work of the solution is, then, represented by the difference, *i.e.*, 115,438. (6) Anhydrous salts generally liberate heat in dissolving; hydrated salts generally give cold. All the salts examined liberate heat during their crystallisation.

New System of Representing Continuous Meteorological Observations, employed in the Algiers Observatory.—M. Buland.—(Note with memoir.)—The author advocates observing and recording the appearance of the sky, in addition to making meteorological observations with instruments. This not only gives more reliable results, but may lead to valuable inductions. He represents, in a graphic table, the hourly quantity of blue sky and of clouds (the various meteorological elements being also given). The sky is divided into ten equal parts; zero represents pure blue sky, or entire absence of clouds; 1, or ten-tenths, represents the sky covered with clouds. Three principal kinds of cloud (cirrus, cumulus, and nimbus) are represented by different colours. Thus, by simply inspecting the table, one sees how the cloudy periods succeeded each other, or how the periods of blue sky succeeded those of clouds. On comparing the various changes with the oscillations barometric, thermometric, anemometric, &c., one readily sees the connexion with these different meteorological elements. The author desires Government assistance in publishing 12 years' observations at Algiers, in addition to those now issued, which begin January, 1872.

Note on Magnetism.—(Continued.)—M. Gaugain.—Physicists find that in horse-shoe magnets the portative force increases with the time of contact of an armature. The author wished to know whether this increased magnetism would be shown by his method of induction-currents. He placed round one of the branches a loop of wire connected with a galvanometer, applied an armature of soft iron, and observed the current of demagnetisation; first, when magnet and armature had been in contact only a few seconds, and next, when the contact was prolonged several hours or days. The current was always the same, and the result is thus in discord with that above stated. M. Gaugain further determined the curve of demagnetisation of an electro-magnet; placing his wire loop successively at different points of the bar, and observing for each position the strength of induced current developed at the moment of interruption of the inducting current. The curve rises from the ends of the branches, reaches a maximum at a point covered by the bobbins, and then gradually falls to the heel. Thus its inclination changes sign four times throughout the length of the bar. Now if one examines with a magnetised needle the magnetic state of an electro-magnet, one also finds that the magnetism changes sign four times. Starting from the boreal extremity, for example, the magnetism at the other side of the nearest bobbin is austral, it is zero at the centre of the bar, becomes boreal on approaching the second bobbin, and, finally, is austral beyond this bobbin at the end of the bar. This correlation is a striking one. In the case just described no armature was applied: where there is such, then, to obtain the curve of demagnetisation a new series of experiments have to be made. The loop being placed successively at various points of the bar, one determines for each point the value of the detachment-current (meaning by this the current induced when the armature is detached). By means of this curve, and the curve of demagnetisation obtained when no armature is applied, one may easily trace the curve of demagnetisation for the case in which the armature is applied. Studying this curve it appears that the increase of magnetism near the extremities on application of the armature is enormous; it may be 60 or 100 times the magnetism found before application. In the case of a permanent magnet the increase on application of an armature was not more than five or six times the previous magnetism. From this difference it results that if we compare an electro-magnet and an ordinary magnet by Coulomb's method of oscillations, and the method of weights carried, we should find by the former that the electro-magnet is weaker than the magnet, and by the second that the magnet is the weaker. These results are not in contradiction; the first method measuring the magnetic intensity which exists before the application of the armature, while the carried weight depends on the magnetic state produced after the armature is applied, and, as we have seen, the modification of magnetic state by the presence of an armature is very different in electro-magnets and in magnets.

Spontaneous Ascending Movement of Liquids in Capillary Tubes.—M. Decharme.—The author discusses the formula obtained from theoretical considerations based on experiment.

State of the Volcano of Nisiros in March, 1873.—M. Gorceix.—This island, one of the Sporades, is situated at the southern extremity of a line running N.N.E. and S.S.W., and nearly perpendicular to the volcanic axis of the Mediterranean. Several of the Sporades have experienced an increase of volcanic disturbance this year. Since historic times Nisiros has had no eruption with flow of lava till the month of March last.

Researches on the Spectrum of Chlorophyll.—M. Chautard.—This spectrum is characterised by a number of bands, one of which has the special properties of sensibility, sureness (in its division by alkalies, a character not found in the lines of any other organic liquid), and generality. Chlorophyll in plants exists in three different states, distinguishable through the spectrum—in leaves newly formed, in adult, and in dead leaves. In the first case, chlorhydric acid produces *accidental temporary* bands. In the second it produces quite another system of bands, which the author calls *accidental permanent*. In the third (and alcoholic solution) the accidental permanent bands appear immediately, without the intervention of hydrochloric acid. Chlorophyll is much less alterable than is generally supposed. It resists the action of iodine, acids, alkalies, digestive work; at least retaining characters by which it may be detected in mixtures the most complex and varied, and after lapse of considerable time.

New Observations on Presence of Magnesium at the Edge of the Sun; and a Reply to Some Points in M. Faye's Theory.—M. Tacchini.—The author gives observations, from June to end of August, of magnesium line, b, and the line 1474 k, the number of positions each day being noted. These vary from 26 to 60. August shows a maximum. The line 1474 k is always found where the line b is found; but the reverse does not always

occur. Against M. Faye's theory the writer points out, among other things, that the penumbræ of spots are generally very broad, and many of their tongues, or currents, go to the very bottom in a way contrary to that which cyclones would show.

Employment of Chronometers at Sea.—M. de Magnac.—The writer describes observations on board the ship *Jean Bart*; they show that the application of Taylor's series, and of Cauchy's method of interpolation, to the daily working of chronometers gives great precision.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxii., Nos. 3 and 4, September 18 and 25, 1873,

These numbers contain no chemical matter.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, September 3, 1873.

New Derivative of Valeral.—A. Borodin.—The author considers the compound which he obtained to be a polymer of valeral, having many points of resemblance to aldol. It undergoes a spontaneous change in course of time, and deposits crystals of the composition $C_{20}H_{42}O_5$.

Combinations of Bromal and Chloral with Benzol.—Guido Goldschmiedt.—The author has analysed and examined diphenyl-tribromæthan, $C_{14}H_{11}Br_3$; diphenyl-trichloræthan; diphenyl-dibromæthylen, $C_{14}H_{10}Br_2$; and diphenyl-dichloræthylen. He has further investigated the behaviour of hydriodic acid, and of sodium amalgam with diphenyl-tribromæthan, and that of zinc-powder with dephenyl-trichloræthan.

Chlorides of Molybdenum.—Dr. L. P. Liechti and Bernhard Kempe.—By the action of dry chlorine, perfectly free from air, the black pentachloride, $MoCl_5$, is obtained, which was formerly taken to be a tetrachloride. If this is reduced by hydrogen gas at the lowest possible temperature, *e.g.*, 250°, the red, sparingly volatile trichloride, $MoCl_3$, is produced. This, if heated in carbonic acid free from oxygen, splits up into the yellow dichloride $MoCl_2$ which remains, and the brown tetrachloride, $MoCl_4$, which sublimes. The last mentioned compound was previously unknown. The atomic weight of molybdenum has been re-determined. Taking O = 15·96; Ag = 107·66; Cl = 35·37; S = 31·98; then Mo = 95·75 to 95·94, showing a mean value of 95·86. The determination of Dumas was 95·65; and that of Debray 95·66 to 95·84. The pentachloride is distinctly crystalline, and can be fused and volatilised without decomposition. On fusion it congeals to a black, radiating, crystalline mass. A green reflection shows the presence of oxychloride. The vapour is a deep brownish red. The sulphur-yellow dichloride and the red trichloride, which strongly resembles amorphous phosphorus, were only obtained amorphous. The tetrachloride appeared as indistinctly crystalline brown sublimates. The di- and trichlorides are perfectly stable in the air at common temperatures, and insoluble in water. The tetra- and pentachloride are easily affected by oxygen, and especially by moisture.

Existence and Dissociation of the Tetrachloride of Sulphur.—A. Michaelis and O. Schifferdecker.—The authors have isolated the tetrachloride of sulphur, and examined its dissociation, and that of the dichloride. The tetrachloride is composed of—

Chlorine	81·61
Sulphur	18·39
	100·00

It is a mobile, brownish yellow liquid, quite distinct in colour from the red dichloride. When removed from the freezing mixture it boils up and loses chlorine.

Oxytetrachloride of Sulphur.—A. Michaelis and O. Schifferdecker,—The authors obtained and analysed this substance to which they assign the formula $S_2O_3Cl_4$. Its composition is—

Sulphur	25·24
Chlorine	55·85
Oxygen	18·91
	100·00

A white crystalline mass, closely resembling perchloride of phosphorus in appearance, of peculiar irritating odour.

Action of the Sulphite of Soda, and of Sulphurous Acid upon Iodide of Lead.—A. Michaelis and G. Kœthe.—Iodide of lead can be completely transformed by sulphite of soda into sulphite of lead and iodide of sodium. Iodide of lead in the cold is only partially convertible by excess of sulphurous acid into sulphite of lead and free hydriodic acid. At higher temperatures the transformation is almost complete.

Direct Determination of the Constituents of the Carbon Compounds by Combustion.—A. Mitscherlich.—This paper is reserved for full insertion.

On Anilido-Acetonitril.—C. Engler.—This substance, to which the author assigns the formula—

$$N \vdots C.CH_2 \left\{ N\begin{matrix} C_6H_5 \\ H \end{matrix} \right.$$

is obtained by the action of anilin upon monochloro-acetonitril. It is a thick yellow oil, insoluble in water and dilute acids, but readily soluble in alcohol, ether, and concentrated acids.

Products of the Reduction of Acetophenon with Sodium Amalgam.—A. Emmerling and C. Engler.—The authors, correcting views they had previously entertained, state that a body which they described as a secondary ethyl-benzyl-alcohol is the pinakon of acetophenon.

On Propiophenon.—T. D. Barry.—The author has formed and examined crystalline nitro-propiophenon, $C_6H_4NO_2.CO.C_2H_5$; a syrupy nitro-propiophenon; amido-propiophenon, $C_6H_4NH_2.CO.C_2H_5$; and the secondary propyl-benzol- alcohol—

$$C_6H_5C\begin{matrix} H \\ O \end{matrix}H.CH_2CH_3.$$

On Sulpho-Ortho-Toluidic Acid.—M. Limpricht.—This acid, $C_7H_8NSO_3H$, was obtained along with a more soluble isomer. Its potassium, sodium, barium, lead, and silver salts were examined. A bromated acid was formed, $C_7H_6Br_2NSO_3HH_2O$, and its salts were investigated.

Derivatives of Uric Acid.—E. Mulder.—The substances examined were the dialurate of urea—

$$C_4N_2H_4O_4.CH_4N_2O$$

(its aqueous solution gives a rich blue colour with sesquichloride of iron and ammonia), uroxanic acid, and alluranic acid. The latter, a new compound, has the formula $C_5N_4H_4O_4$. The author has also studied—Alloxan-silver; the reduction of alloxan and parabanic acid by hydriodic acid; the oxidation of mycomelinic acid; and the characteristic reactions of alloxantin and dialuric acid. Both give a blue colouration with ferric chloride and ammonia.

Action of Ammonia upon Bromacetyl-Urea.—E. Mulder.—If alcoholic ammonia acts upon bromacetyl-urea in a closed vessel in the water-bath, a colourless product is obtained, insoluble in alcohol. If it is treated with dilute hydrochloric acid, diglycol-amidate of di-uramid dissolves, and there remains a mixture of bromacetyl-urea and another body. From the mixture was obtained a body differing widely from diglycol-amidate of di-uramid in its properties, but not in its composition. The action of aqueous ammonia is different.

Chlorhydrate of Ethylen.—A. Ladenburg.—The author obtains aceto-chlorhydrin, $C_2H_4(OC_2H_3O)Cl$, by heating 1 part of chlorhydrate of ethylen with 1½ parts of anhydrous acetic acid in a sealed tube.

THE CHEMICAL NEWS.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Bradford Meeting, 1873.

SECTION B.—CHEMICAL SCIENCE.

President, Dr. W. J. Russell, F.R.S.

(Continued from p. 186).

"*The Bradford Sewage Works.*"—Mr. Andrew Leighton (London) gave a description of "The Bradford Sewage Filtration Works," in the course of which he said that it did not admit of a doubt that the purification of sewage, so that the effluent water could mingle innocuously with any stream, could be accomplished by the Peat Engineering and Sewage Filtration Company; but whether at a profit was an unsolved problem. Owing to the *vis inertiæ* of the farmers the sale of the manure was but slow, but the consumption was gradually growing. The principal reason of its sale being so backward was that its chief ingredient was charcoal, which bore no value in the analysis of the agricultural chemist, though the crops grown under the company's manure were the finest in England.

In the discussion which followed on the sewage question, Mr. Stanford (Glasgow) said that with regard to the general report of the Sewage Committee, he had had the pleasure now of listening to it for several years in succession, and he was very glad to find that the gentlemen, in educating the country, were greatly educating themselves. They were at first, as Mr. Hope had happily expressed it, rather ill-connected, but they had been gradually picking up much better connections. First of all they were to have the country floated with sewage thrown over the fields just as it was, and now they were recommended to separate systems. He had pointed out some years ago that they must have a separate system for the sub-soil water, and one of pervious sewers for the drainage water. They were going now, instead of throwing the water over the land, to have it passed through the land. It was to be filtered, and it was also to be precipitated. All these were great improvements. He was extremely sorry, however, that the gentlemen who had formed the committee were now going to sit in their chairs and throw up any further trouble.

Mr. P. H. Holland (Medical Inspector, London) said Mr. McGowen had very wisely directed their attention chiefly to the part of that very extensive subject in which he was best qualified to speak with authority, and which stood most in need of clear elucidation. Nearly all who had considered the question were well convinced that the proper destination of the very diluted manure called sewage was for the fertilisation of the land wherever land was accessible at a cost which could be repaid by the value of the manure, and, with a few exceptions, all were convinced that the objections urged against sewage irrigation, when properly applied, were either false or frivolous, very similar indeed to those often urged by those very intemperate arguers—advocates of temperance—who contended that because drinking to intoxication was injurious, therefore drinking without intoxication was so. By similar reasoning it was concluded that sewage irrigation properly done must be bad, because it would be if so used as to turn a pleasant meadow into a putrid swamp. Now this was exactly the difficulty. Some places were so situated that access to a considerable extent of land could not be obtained except at a cost out of all proportion to the profit to be expected, and until legal difficulties were removed such places were therefore compelled to run the risk either of converting a small area of land into a putrid swamp, or of spending a large amount that would never be repaid, or of so far partially purifying the sewage that it might without offence be turned into the river, which was perhaps the best course to follow until the legal impediments to a better were removed. The local authorities were now liable to be forbidden by one injunction to turn foul water into a stream, and by another to divert any water from it, thereby diminishing its volume. Those using it for power claimed not merely its natural volume, but any addition that might have been artificially made to it. In the case of Bradford this artificial addition to the dry weather stream had been very considerable, 12,000,000 gallons being daily conveyed from the valley of the Wharfe to the Aire, and any quantity of sewage not exceeding that might be diverted from the Aire without reducing the stream below its natural volume; and no compensation ought to be paid unless the stream were diminished more than it had been artificially increased. Such a conservancy board as Mr. McGowen had proposed, with representatives of each interest affected, could be safely entrusted with larger and more varied discretionary powers than those representing ratepayers only. They should at least have powers throughout the whole of their district similar to those exercised by town councils within their boroughs; *e.g.*, they should be authorised to construct conduits wherever necessary for conveying sewage from the places where it was doing mischief to those where it could most conveniently be disposed of, without paying any other compensation than for land actually occupied, and for damage actually sustained. There need be no payment by a board having perpetual succession for possible prospective damage, as such board could at any time defray any legally-established claim. Such board should have power to purchase or hire by agreement any land suitable for irrigation, on condition that it was so used as not to be a nuisance. No one had a right to prevent another using his land in any way he pleased, merely because he imagined it might prove annoying. He must prove that it was so before he could prevent the land being so used; and it was very certain that the same quantity of manure put in the same land would be less, not more, annoying if it were mixed with a larger quantity of water, provided such water were not allowed to stagnate; and unless the manure were used in excessive and wasteful quantity, it need not be perceptibly offensive at all, and very rarely was so. Although he was not convinced that irrigation of land was the right mode for disposing of sewage, he quite expected that it would ultimately be resorted to for Bradford. He thought no one would doubt the wisdom of trying, as a temporary experiment at least, the possibility of so far purifying the sewage as to postpone the necessity for extensive works, which could not be effected without considerable change in the law; but the necessity of change of law had become so apparent that the representatives of large towns would find it indispensable to take common action, and insist upon such changes being made.

The Lord Provost of Glasgow said he thought there were two things involved in this question. One was that different towns required different appliances; that one scheme would not do for every place, and that separate schemes were necessary for different towns. There was another conclusion which he thought they had all arrived at, and that was that the return, in a pecuniary point of view, was not likely to be satisfactory. There were one or two questions which he would like very much to ask, because he thought that the report from the general committee required their very greatest attention. He thought that there were some things in the report with which all parties would agree. One was that irrigation could be adopted with great advantage. Constituted as they were in Glasgow, they had in their neighbourhood a large extent of sandy soil, where the sewage could be removed, and in all probability give rise to a very considerable return of crop by being put there. It appeared to be the opinion of the engineers whom they had consulted that the removal of water carriage in that way would be very effective indeed. He quite agreed with the report of the committee that the

conservatism of sewage—that was, keeping it in the same place—must be condemned; at least he might say that, so far as they had found in all their experiments, they had not found one satisfactory plan by which they could recommend that to be put in operation. He would like to ascertain from the committee whether, in the consideration which they had given to the matter of irrigation, they included the chemical refuse in the sewage that they proposed to apply in the way of irrigation, or whether in the refuse of large towns the chemical ingredients would be as effective as if some process were taken to separate the one from the other; also, if they had made any calculation how much an acre of land would bear per annum of sewage; and whether they advocated intermittent sewage or a constant flow of sewage to be put on the same land.

Mr. B. LATHAM, in speaking of the report of the committee, said he did not think that such an association as that should issue dogmas which were not in accord with the experience of the country. One of the things they had been told was that the drainage must be carried out upon all irrigation grounds; but they had not been told in what way that drainage was to be carried out in order to secure the purification of the sewage. It was an important thing, and they all knew that drainage had a beneficial effect in irrigation on the soil, but in some cases it absolutely prevented the proper purification of the sewage. Where the surface of the soil was deep drainage was unnecessary, and where the surface was flat there drainage was absolutely necessary. With regard to the Bradford works, there was no one system which could apply to all parts. There were some cases in which dry conservancy must be carried out in conjunction with some system of drainage, but there was no way in which drainage in some form was not absolutely necessary.

Mr. HOPE (Chadwell Heath) said that as regarded drainage, if it was necessary in ordinary farm land, *a fortiori* it was necessary in clay land and in irrigation. If Mr. Latham was bound to take up his drains, it must be because they had not been properly put in. If they drained clay land they must drain it deeply. If they spent money upon the matter, they would get it properly done. He referred at length to the case of Birmingham, which recently came before Parliament, and of which, having himself been engaged in the proceedings on the bill, he was able to speak from personal knowledge of the details. With regard to the Aire and Calder Conservancy Bill, he did not know much about it, but he had heard that some land-owners were unkind enough to call it a bill founded by the wolf to protect the lamb in the stream. He was sure that no one could look at the town clerk of Bradford and say that he looked like a wolf. He would not admit that there was any town in the country which could not get land if they went to the expense. If there were towns on the upper branches of a river, the waters of which people wished or required to drink, then they must be made to purify their sewage at whatever cost. The cost was a secondary consideration, health being evidently the first. As to the London scheme, he might say that the Metropolitan Board of Works had no power at the present moment to deal with sewage.

Mr. BLAND suggested that it would be better if something could be found out by united efforts which would enable sewage to be efficiently precipitated and purified.

Dr. GILBERT said he understood the gentleman who spoke of the process now being adopted at Bradford to say that the whole of the manurial matters were retained. Without binding himself to any one particular figure, he would say that the sewage, as derived from domestic sources, would not contain more of its nitrogen than one-fourth on the average and even less; but, at any rate not more than one-fourth of it could possibly be precipitated from the liquid and retained in the manure. They had not been favoured with the results of any analysis of the deposited manure, and without those they could not form any definite opinion. With regard to the three-quarters or more of the valuable matters and the putrescible matters which were left in the sewage after any such process as they had had described, the only way and the best way to purify that sewage was by irrigation if it could possibly be carried out. That was the only possible means and the only known means of its utilisation.

Mr. CHARLES ELCOCK (Manchester) hoped that the committee would not cease its labours at the present time. The whole question of the treatment of sewage was one almost as yet in its infancy.

Mr. STANFORD (Glasgow) proposed the reappointment of the committee.

Mr. MCGOWEN (Town Clerk of Bradford), in seconding the motion, said that the discussion which had taken place proved most satisfactorily and conclusively that if the committee which had been appointed to investigate this matter were to bring before the public anything thoroughly practicable and thoroughly useful, they ought to be reappointed again and again until they could arrive, not merely at some sound theories applicable to some districts, but at a good rule that should be applied to districts of special characters in different parts of the country. Mr. Hope had spoken of the land as easily to be obtained, but he ventured to assure him that it was not so. But Mr. Hope had said they might go 10 miles, and if they could not find it within 10 miles they might go 20. Now there was no magic in that, and therefore he would say that if they could not find it within 20 miles they might go 30. Now could there be anything more rash than such statements from any one coming into this part of the world, seeing how this part of the country was situated, its configuration, and the everlasting changes of altitude? Besides, had anybody ever contemplated the expense which would be the result of such a proposal being carried out? Mr. Hope had given them the most opposite illustration of all the difficulties which surrounded this question that he possibly could have selected. Referring to what Mr. Hope had stated in regard to the case of Birmingham, he said that when it was proposed to convey the sewage into a particular district, gentlemen were sure to say that it would depreciate their property. They might, if they chose to put it so, be as much mistaken in that as it was possible for a man to be mistaken, but he could not believe for a moment that a money object alone guided them. In such cases every man who had a piece of land to sell always declared it to be the best piece of land in the country. But let them look at what that led to. They could not get the land without going to Parliament. They applied for certain powers, and after acquiring the land and erecting the works, they might have a suit in Chancery about once every morning. He concluded by saying that he hoped the committee would look at the question in a serious point of view. The public would not have the streams polluted—let them avoid by all means recommending to enormous centres of industry, surrounded by tremendous difficulties, schemes that were very applicable indeed to sparse populations, but wholly inapplicable to such populations as these.

ON THE ESTIMATION OF CARBON IN PIG-IRONS.

By CHARLES H. PIESSE.

MOST persons interested in the analysis of pig-irons have found that the process of filtering the separated carbon through a piece of combustion-tube narrowed at one end and partially plugged with asbestos, mentioned by Fresenius on page 573 of the third edition of his "Quantitative Analysis" (Bullock's translation) is anything but satisfactory. I have been using for several years a modification of that method which has the

advantage of allowing the operation to be rapidly completed. It is as follows:—

Place an accurately weighed quantity of about 3·5 grammes of the pig-iron (fine drillings) into a beaker, and pour upon it about 35 c. c. (10 c. c. for each 1 gramme) of a solution of cupric chloride, which has been made thus:—

Take of—

Cupric chloride	500 grms.
Sodium chloride (saturated solution)	900 c.c.
Hydrochloric acid (ordinary pure, sp.gr. 1·16) ..	50 c.c.
Distilled water	50 c.c.

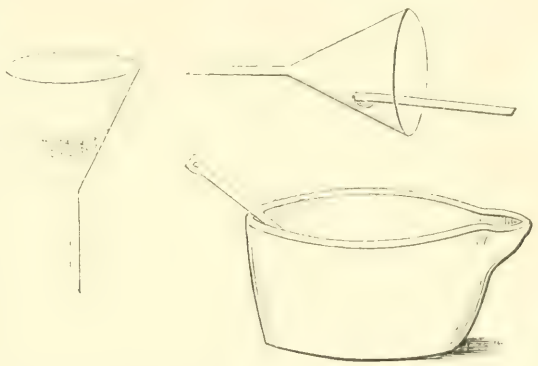
Dissolve the cupric chloride in the solution of sodium chloride, and add the mixed acid and water. Filter the whole.

This solution should be quite transparent, and it is advisable to test it before use, by pouring some upon a sample of pig-iron known to contain a rather large quantity of combined carbon. Any evolution of hydrocarbons will indicate that the solution is too strongly acid. This only occurs when the cupric chloride contains a lot of free hydrochloric acid. It can be remedied by further drying the $CuCl_2$ over the water-bath, and making another batch of the solution, in which 50 c.c. of distilled water are substituted for the 50 c.c. of HCl, and then mixing the two batches.

The beaker containing the pig-iron and cupric solution is covered with a clock glass and allowed to stand for 2 or 3 hours in a warm place. By that time nearly the whole of the iron will have been dissolved, the carbon separated, and some metallic copper thrown down. The dark brown liquid produced (which consists of ferrous and cuprous chlorides) is to be very carefully decanted on to a filter directly to be described, a little more solution of $CuCl_2$ then added to the residue in the beaker, and that in its turn after standing a short time to be also filtered. This fresh addition of $CuCl_2$ to the residue and subsequent filtration to be made as long as any iron remains undissolved. Generally, however, two or three additions of the solution after the first are sufficient. It is advisable to keep the filter covered with a watch-glass between these successive filtrations to prevent the mass upon it from drying. The carbonaceous residue is then thrown on to the filter, and the beaker rinsed out with a saturated solution of NaCl, and cleaned by means of a cut quill in the usual way. The mass upon the filter is then to be thoroughly washed with the solution of NaCl until no iron or copper can be discovered in the filtrate on testing a few drops of it collected in a test-tube for the purpose, with K_4FeCy_6 and K_3FeCy_6. The NaCl is then removed by washing with distilled water, and when nothing is left on evaporating 3 or 4 drops of this filtrate upon a platinum spatula, the washing is continued with boiling concentrated HCl (sp. gr. 1·16). This washing with HCl removes a quantity of iron, existing probably as hydrated ferric oxychloride from the unavoidable exposure of the ferrous chloride to the air. The iron being thoroughly removed by the hot HCl, that is now to be most perfectly washed out with boiling distilled water, and when every trace of it is gone, the carbonaceous mass is to be dried at 100° C.

The filter consists of a glass funnel into which a nearly circular slab of glass or porcelain* about ¾ inch in diameter has been so placed that it lies horizontally. The slab is covered with a layer of broken, nearly powdered asbestos, from ½ to ¾ inch in thickness, that being well wetted with saturated solution of NaCl so as to sink it firmly together. A glance at the figure will render this description clear. A portion of the filtrate from every fresh decantation should be largely diluted with H_2O after adding a sufficiency of NaCl solution or HCl, to keep the $CuCl_2$ dissolved, and examined by transmitted light; if any particles of carbon are floating in it, the whole must be re-filtered, but if the filter has been properly made this will never happen. When the carbon on the filter is perfectly dry, the funnel is to be inverted over a Wedgwood mortar containing some cupric oxide; the slab by being pushed from behind with a thick platinum wire falls with the asbestos and carbon on to the CuO in the mortar. The slab is then taken up with a pair of clean brass tongs, and should there be any carbon adhering to it (which but very rarely indeed happens) that is removed by rubbing it in the CuO, or by scraping it with a little clean asbestos. Attention is then turned to the funnel, to which nearly invariably some carbon adheres. This carbon is best removed by holding the funnel horizontally with one hand, and then putting a little CuO over a part of the carbon, covering that with some clean asbestos, and pressing on to it with a small platinum spatula, whilst revolving the funnel slowly, in its horizontal position; after one or two revolutions of the funnel the carbon will be entirely scraped off. To secure accuracy, this operation should be repeated twice or thrice. The position of the funnel, &c., is shown in Fig. 2.

FIG. 1. FIG. 2.



The whole contents of the mortar are then thoroughly commingled by stirring with the pestle, the mixture being transferred to a combustion-tube in the ordinary way, and burnt in the style of an organic analysis. It is advisable to pass oxygen for about 10 minutes through the combustion-tube towards the end of the operation, to ensure complete oxidation of the graphitic carbon. By heating the mortar and CuO (which must of course have been previously heated to dull redness to expel moisture) in the water oven to 100° C., this is prevented from absorbing moisture; but, nevertheless, a $CaCl_2$ tube should be interposed between the combustion-tube and the potash bulbs.

I need hardly add that by multiplying the weight of CO_2 found by 27·27, and dividing the product by the weight of the pig-iron used, the result will represent the percentage of carbon in the pig-iron.

303, Strand, London, W.C.

* Easily made with pincers or champfers from a broken crucible-lid or glass plate.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 191).

GUNPOWDER has been introduced solely for the purpose of illustrating the questions that might arise in reference to the physicist's and chemist's views of affinity, and not for any purpose in reference to its use in mining or war.

If its introduction has made clear that the affinities amongst the atoms of which it is composed may be controlled, that the intensity and rate of its explosion (which is but another name for chemical combination) may be

* The Cantor Lectures, delivered before the Society of Arts.

regulated—that it and its related explosive agents may exercise their affinities without danger—harmlessly and slowly, then the inquiry is at once suggested, on what elements do chemical combinations depend? Why are these combinations accompanied with devastation and ruin. Why are they peaceful and unperceived?

Those who were present at the first lecture will be prepared for the suggestion that these differences arise (in part, at least) from some of those results which in that lecture were said to be deducible from a consideration of the units of time, mass, and space. Those fundamental units form a combination on which all our knowledge of work and production of energy depends. It will probably be remembered, too, that in the lectures on gravity and vitality these units of measurement formed the object of research by the men who have given to society the mode of estimating these energies.

It may have been noticed that whereas in the other lectures of this series the titles have in them the words, "especially with reference to the measurement of it," these words are changed in the title of the present lecture, and there are substituted for them the phrase, "especially with reference to considerations for measuring, &c." It will now be not inappropriate if one or two of the causes which lead to this difficulty in estimating the energies of affinity be made as clear as the competency of your lecturer will permit.

Before entering upon this, it may be well to consider whether the actual putting forth of the energy of affinity is a phenomenon belonging to physics or chemistry. The answer, open to contradiction by many, is that the study of the energies of affinity is a purely physical question, and not a chemical one. For this reason a chemist deals with those combinations in which the constituent elements have passed through such changes that their identity is lost. The chemist is ever dwelling upon changes, and his equations are not the equations of the physicist and the mathematician; they are, by the use of mathematical symbols, the representatives of change, of what affinity has done and completed, and not of that energy with which it has been done and which is to be measured. The energy of affinity either causes or induces these changes, and until that energy has operated chemistry has no standing ground. The energy of affinity opens the gate which separates the domains of the chemist from those of the physicist, and as the physicist is in possession of the matter the chemist must look there before he can take note of those changes he so loves to contemplate.

It is quite true that when the physicist and mathematician attempt to apply those principles which serve so well in investigating the measurement and utilisations of the other imponderables, they are baffled. By the application and study of these principles it is moderately well known how to call forth that which we wish to call forth. The summons being issued, we can rely upon the same result, whatever may be the surroundings. Not so with the energy of affinity; it is now slow, now sudden, now destructive, now restorative, now brought out by heat, now by light, now by moisture, now by sound, now by time, now by the simple presence of another molecule.

It is similar to the other energies with which we are dealing, in that it seems to consist in a species of attraction or its opposite repulsion. Gravity has a power of attraction at all distances; electricity has both attractive and repellent powers, and we may say at all distances; but affinity is limited to molecules so near that we must say that the matters of which they consist are in absolute and perfect contact.

That there is what we call matter—that it is of such a character or nature as that no two particles of it can at one and the same time occupy the same space; that however much a lump of this matter be divided it may still by finer instruments be sub-divided; that by neither mechanical nor chemical means has any one ever yet obtained one such ultimate and indivisible particle of matter. These are assumptions generally received without controversy.

It is, however, in and amongst these ultimate and indivisible particles of matter that the laws of affinity operate. If we could handle them as we handle the bulks which the aggregation of these particles form, then, probably, all difficulties respecting the laws of affinity would vanish. We cannot handle them. The physicist gives it up in despair; the chemist, however, more venturesome, deals with them. In dealing with them he puts forth a proposition which the physicist knows not how to accept.

Such unions and interlacings as these seem to set at nought the postulate that no two particles of matter can occupy the same space. For the chemist recognises two, three, four, or five particles of matter, seemingly rushing together, and, as far as we know, occupying the very space which a fundamental physical proposition states they cannot occupy. It may, however, be quite true, for telegraphic messages now-a-days run along the same wire in opposite directions at the same time.

If we could but reconcile these views (and they will be reconciled some day), what a change will come over the dreams of scientific theorists, and what a magnificent and splendid territory for scientific research will then be brought into possession.

To return to the difficulties which interfere with an enunciation of the laws of affinity.

It is plain that explosives, as they are called, vary in their manifestations to our senses in respect of intensity (the assumption that the energy of affinity always produces a species of explosion is not a very violent one). But it is not so plain that within themselves the intensity is a constant quantity, and admits of no variation—that whether gun-cotton causes a cliff to crumble as powder into the sea, or flashes harmlessly without even igniting the gunpowder laid on the palm of the operator's hand, the energy of the affinity in the two cases is exactly the same. In fact, affinity can neither be created nor destroyed—it may be resisted, and if the resistance could be measured at the moment affinity may be said to put forth its energy and overcome the resistance; then this is the measure of the energy. Illustrations of this are numerous and convincing. Let a few minutes be given to one.

If a person raises 100 separate 1 lb. weights off the floor on to a table 3 feet high, then, as a measure of the energy expended, we take the work that is done, viz., 100 separate lbs. raised 3 feet, and call the product 100×3, viz., 300, as the measure of the energy of vitality which thus raised the weights. Suppose, now, the man had been ten minutes in doing this work, then the energy per minute would be measured by the figures 30. Suppose that instead of working at this rate he had lifted all the weights in one minute, the energy per minute would be still measured by the figures 300, and if the rate of work were continued there would have been expended in ten minutes an energy represented by the figures 3000. Thus we may reason until the work, originally done in ten minutes, is done in one second. The measure of the energy in that one second is 300, and in one minute 18,000, and in ten minutes 180,000. The intensity of the energy in this last experiment is 6000 times as great as in the first experiment. Let this illustration suffice to show that to measure the intensity of an energy time must be taken into account if we wish to utilise that energy, or to bring it into calculations.

It will be within the memory of those present at a former lecture that, in the case of the energy of gravity, Atwood brought time in by staying the sudden action of gravity and distributing the fall of a weight through a large mass. Kater brought time in by causing a pendulum to record the number of its vibrations. They dealt with gravity alone, but as we are dealing not only with the energy of affinity alone, but with such concealed and unknown energies as those which

are taking place, whilst the phenomena we are observing are going on. If we could put two substances together, and could guarantee that neither nascent nor catalytic action should be taking place, then we should have an energy responding as a unit to the energy of gravity. So if we could prolong the time we might, somehow or other, get a record of the energy. But that we cannot do, and with all our modern appliances it seems almost impossible to notice the time when affinity begins and ends its work. Under any circumstances it is difficult to notice time, but when the interval is short, what is called the personal error is as great as though the time were long.

A digression may make this clear. Suppose the eye sees an event, a nerve of sensation conveys the impression to the brain, and then a nerve of motion directs the muscles of the fingers to record it. Now, in the case of affinity, before the nerve of sensation has telegraphed to the brain the commencement of the event whose duration we wish to record, the end of the event is there, and the retina has impression superimposed upon impression, and the fingers fail to enter the records. This leads to another difficulty—the nerves of different persons transmit impressions at different rates; hence observations and records of the duration of things seen and heard by two people do not agree, and certain corrections have to be introduced consequent upon these personal differences in the speed of these nerve-conveying telegrams.

As regards mass. Assuming that our investigations are carried on in the same locality, then, speaking generally, mass is fairly measured by weight *in vacuo*. If the bodies we see and handle were units, then we might recognise mass as the weight of the visible body. These bodies are composed of elemental units, the masses of which we cannot see, and affinity deals with these elemental unit masses, and not with the bodies themselves. Certain considerations, based upon numerous observations, led Dalton and others to conclusions in regard to the weights of these ultimate unit masses. Admitting all to be correct, they are not sufficient for the purpose of estimating the energy of affinity through the fundamental units of time, space, and mass.

The failure is thus—Dalton, finding hydrogen the lightest substance, compared all others with it. But what is the actual weight of a hydrogen atom? That we do not know, therefore we cannot know the weights of the other substances which are recorded in this.

If the absolute weight of one elemental unit of any simple body could be had, then, thanks to Dalton and others, the absolute weight of the unit elements of all other bodies is known.

For the purpose of making clear the value of these atomic or molecular elements in reference to their mass and the space between them, let me, at the risk of some repetition, remind you that knowing the weight of one atom or molecule of each of the bodies, the energy of whose affinities is to be measured, and knowing the space between them and through which space these atoms or molecules pass before they coalesce, then the product of these two elements gives the value of the energy in the form of work done. If with this product the time is combined, then not only the energy, but the intensity of the energy is also known.

Now, if we cannot get at the unit *masses*, how can we possibly get at the distance between them; yet this distance is the *space* through which these little masses must be carried by the influence of that affinity whose energy is to be measured by the work it does.

When, however, we consider that the waves of light have been measured, the number of them, per inch, stated, their velocity ascertained, we have good grounds for assuming that the masses and distances of the ultimate elements of matter will also be ascertained; then the laws which regulate the energies of such affinities will, most probably, be also ascertained.

Such are some of the preliminary difficulties which present themselves to those who look in hope to establish the laws which govern the energies of affinity from first principles.

If, however, these laws be enunciated—if they be even approximately attained—it will most probably be through some indirect means, through some other energies from which these energies of affinity may be deduced. In this indirect way the mechanical energy of heat has been measured, and its value is as generally received and acted upon as that twelve pence make one shilling or twenty shillings make one pound.

The source of mechanical power, so far as men utilise it, is in the energies of affinities. To these energies, as formed by the Creator (inherent and primordial), we owe the means by which work is done. Indeed, it is no very bold suggestion to make, that to the exercise, even now, of these inherent affinities, we owe much—it may be all—of terrestrial magnetism and internal terrestrial change and heat; the progress, in the depths of the earth, of these affinities, may be the cause of the variation of the compass; nay, we cannot tell where speculations such as these lead. How the atoms disport themselves we know not; this we do know, that when some atoms meet some other atoms they are as Greek joined to Greek, for "then comes the tug of war."

(To be continued.)

CORRESPONDENCE.

TURACIN.

To the Editor of the Chemical News.

SIR,—On my return lately from Angola, I had an opportunity of purchasing, from the natives in the Market at Sierra Leone, a quantity of the beautiful red feathers of the "plantain-eaters;" and, being desirous of verifying the extraordinary results published by Mr. Church in the *Phil. Trans.* for 1869, I gave them to my friend, Mr. Henry Bassett, F.C.S., to examine, and he has kindly supplied me with the following note as the result of his investigation:—

"From 300 feathers obtained 1·045 grms. turacin. Two copper determinations, made by fusing with nitre and carbonate soda, washing out with water, then dissolving the oxide of copper in nitric acid, filtering, and precipitating with potash, gave quantities of oxide copper corresponding to 7·6 and 8·0 per cent of metallic copper. Church found 6·0 per cent; on the other hand, the feathers yielded him a larger quantity of the colouring matter. General characters, appearance, &c., exactly in accordance with Church's description; insoluble in benzol, sulphide carbon, tetrachloride carbon. The copper to be unmistakably seen by burning the smallest portion of a feather in a Bunsen burner."

These lovely birds are common on the west coast of Africa, and on that part of it that I am well acquainted with, viz., from Loango, in 5° S. lat., to Little Fish Bay, in 15° S. lat., their loud and prolonged cry is to be frequently heard in the thick forest, where they find their fruit food most plentifully. Over the whole of the country I have mentioned, and for a considerable distance inland, copper is found most abundantly distributed as malachite, or green carbonate; in fact, specks and indications of the green mineral are to be noticed almost everywhere. Whether such is also the case on the west coast, at Sierra Leone, Senegal, &c., where these birds are, I believe, still more usually found, I cannot say; but there is no doubt that in the large extent of country I have mentioned and explored for many years, and where these birds are common, copper is found very extensively disseminated. I am unable to say whether the copper enters their system as a constituent of their food, as suggested by Mr. Church, but I believe it most probable that these birds are attracted by the bright green of the malachite,

and swallow small particles of it with the gravel, &c., that they, in common with all birds, consume with their food.

These red wing-feathers are sold and used by the natives of the west coast as a "fetish," being employed as charms in sickness, &c., and the bird itself in Angola is considered as a great "feiticeiro," or witch, being said to warn travellers with its loud cry from danger of robbers, animals, &c., lying in wait to attack them; and its cry, if uttered in a village or town, is reckoned as a very bad omen.

Trusting the above notes, in verification and explanation of Mr. Church's singular results, may prove interesting to your readers, I am, &c.,

J. J. MONTEIRO,
Associate of the Royal School of Mines.

AN INDIGNANT PROTEST.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS of August 8, 1873, an article is published which gives an account of the alleged "discovery," by a French chemist, of a "new" method of estimating *iron* by means of the decolorisation of the blood-red solution formed by adding sulphocyanide of potassium to one containing iron peroxide.

If you refer to your file of the CHEMICAL NEWS for 1868, you will find published there (I forget in which month) a letter from me suggesting this very operation; and my suggestion was negatived in the next number of the CHEMICAL NEWS by (I think) a Mr. Wright, who satisfactorily (to the English chemists) proved that it was "impossible." I quite agree with the Frenchman that nothing is "impossible," but *he* might have had the justice, and *you* the memory, to give me credit for the "idea."—I am, &c.,

W. A. Ross.

Shooter's Hill, Kent,
Oct. 8, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, September 15, 1873.

Products of Oxidation of Meteoric Irons compared with the Terrestrial Magnetites.—According to considerations already developed the terrestrial rocks, taken in their totality, behave like the epidermis of a globe whose lower regions are constituted by masses resembling the meteoritic rocks. Veins of ferrous oxide may be taken to represent the upper portions of veins of massive iron comparable to the siderites. On oxidation under certain conditions the nickel is eliminated. The characteristic structure of meteorites is found to be entirely destroyed by oxidation. A fragment of iron from Charcas was heated to redness for five hours in a current of steam. It was then allowed to cool, the coherent mass of oxide was polished, and then treated with very weak hydrochloric acid according to Widmanstætten's procedure, but no figure appeared.

Preparation of a New Anilin Red.—M. E. Ferriere.—An acetate of anilin is formed, mixed with ammoniacal hydrate of copper, and saturated with sulphuric acid, when a fine purple-red colour is developed. After concentration the liquid on standing deposits crystals of sulphate of ammonia, which are filtered off. The new anilin-red remains then transparent.

Reply to M. Tacchini's Last Note.—M. Faye.—M. Tacchini had cited (as in opposition to M. Faye's theory) the case of two spots observed by the Italian spectroscopists, in which the internal gyration was in contrary directions, although the spots were in the same hemisphere. The author reproduces drawings of these spots, and points out that one of them is in advanced segmentation; and that one segment is gyrating in one direction, the other in the opposite. Now, only intact spots (as he had before said) should be compared. Then M. Tacchini again insists on the appearance of protuberances where there are not spots. M. Faye, with the view of elucidating this point, makes the following propositions:—(1) The sun's surface is studded with innumerable pores, giving a shagreened appearance. Those with appreciable dimensions have a diameter of at least one second, representing an opening of 167,000 square miles. (2) The spots are enlarged pores. (3) The spots finish as they commence, returning to the state of pores, finally imperceptible. (4) In these successive transformations there is one element which is unchanged, viz., the primitive axis of the pore. (5) There are two zones parallel to the equator where the change of pores into spots is frequent, and where the spots retain enormous size a long time before becoming pores again. (6) Beyond these zones, at the two polar calottes and the equator, the pores only become spots for a few instants. The phenomenon is very rare from 40° lat. north or south in each hemisphere, and beyond 52° the pores never acquire the size of spots. All this being allowed, M. Faye's theory attributes the circulation of hydrogen to the mechanical action of pores, these being considered as vertical cyclones produced by the unequal velocity of contiguous zones of the photosphere. When the pores are accumulated in certain regions they may give exceptional activity to this circulation and produce protuberances. The heliographic distribution of these, therefore, simply indicates pores more or less accumulated. In times of exceptional cyclonic activity groups of pores, and consequently protuberances, should appear near the poles and near the equator, and this agrees with fact. The pores become spots where the cyclones have most stability. These spots produce more marked protuberances than accumulation of pores does elsewhere; but it is by the same mechanical action. In short, the solar vortices, both spots and pores, produce protuberances; hence it is not surprising that protuberances appear where there are no spots. The author adds sketches of the development of a pore into a spot, and the return to the original state.

New Researches on the Analysis and Theory of the Pulse in the Normal and the Abnormal States.—M. Bouilland. (Extract).—The author distinguishes four periods in each "arterial revolution," or the changes occurring from commencement of one pulsation to that of the next. Of the two *shocks* the first (known as the *pulse*) is produced by the ventricular systole of the heart; the second results from systole of the arteries (which are passive in the first, active in the second). These two alternating shocks constitute the normal *dicrotism*, of which the abnormal dicrotism is merely the intensifying, simple or double, that is affecting either one shock or both. In opposition to Harvey and other physiologists, the author supposes in the arteries an *impulsive* force without which the transport of the blood into all parts of the body could not be effected. The co-ordinated movements of arteries and heart are ruled by ganglionic innervation, but the precise situation of the co-ordinating nerve-centre has yet to be discovered.

Changes of Form of the Comet 1873, IV.—MM. Rayet and André.—This comet (of which a drawing is given), as observed on the night of September 3, had a

tail about 2° long, while the head was about eight or nine minutes diameter. The nucleus, at first in the centre of the nebulosity, had taken an excentric position near the part furthest from the tail. Other details are given.

Motion of an Elastic Wire, one Extremity of which is Animated with a Vibratory Motion.—M. Mercadier.—The author has studied, with the aid of his "electro-diapason" (formerly described), the motion of an elastic wire fixed to one of the extremities perpendicularly to the plane of vibration. Taking any length of wire, one or other of two cases will occur. (1) The wire divides into a certain number of concamerations with a free extremity, the vibration of which, like that of the whole wire, is executed parallel to that of all the points of the diapason. A node seems at greater or less distance from the diapason, the vibratory intensity and amplitude of which are not sensibly altered by the presence of the wire. This case is distinguised as the *normal vibratory state*. (2) The wire presents complex vibratory forms indicating superposition of movements, and sometimes "turning" vibrations. The free end from the last node takes the form of a horn of varying section. This case especially occurs where the wire is thin; and in all such vibratory states (termed *abnormal* or *transitional*) there is a diminution of the amplitude and intensity of movement of the diapason, which may even extend to extinction. In the present note the normal vibratory state is studied. The number of nodes, the nodal distance, and the length *l* vibrating freely, depend on the length L of the wire, its diameter, and the number of vibrations of the diapason. From a table of results several laws are deduced. [D stands for the first nodal distance, or distance from the first node to the second; D the other nodal distances, except the last, called *d*; after the last node comes *l*.] (1) Whatever the length, where the wire vibrates regularly, it always vibrates synchronously with the diapason. (2) For the same wire the nodal distances, except the first D and the last *d*, are equal. (3) For the same wire, whatever the length, *l* is constant and equal to the third of the normal nodal distance D. (4) The length of the wire being varied, *l*, *d*, and D remain invariable till there is only one node; the distance of the first node from the diapason alone varies. (5) Other things equal, the normal nodal distance of wires of the same nature are to each other as the square roots of their diameters. (6) For different diapasons, the normal distances corresponding to the same wire are inversely as the square roots of the number of vibrations of the diapasons. (7) If the amplitude of the diapason is varied (*e.g.*, by varying gradually the intensity of the pile) the form of vibration of the wire does not change, but the three or four first nodes near the diapason are displaced; removing from, or approaching it, according as its amplitude is increased or diminished. This displacement decreases very rapidly from the first to the last node displaced.

Product of Oxidation of Meteoric Irons; Comparison with Terrestrial Magnetites.—M. S. Meunier.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, September 3, 1873.

On Silver Urea.—E. Mulder.—The author formed a compound of urea and silver by precipitating with soda a mixed solution of nitrate of silver and urea. It is a gelatinous light yellow precipitate. Silver urea is insoluble in water, but soluble in ammonia. It consists of—

Carbon	4·4
Hydrogen	0·8
Nitrogen	9·8
Silver	78·8

and its formula is probably CO.2NHAg. It does not explode when heated like silver carbodiimid.

Behaviour of Monochlor-Phenol Boiling at 218° on Fusion with Potassa.—Aug. Faust.—The author finds himself unable to confirm the results of Petersen and Bæhr Predari, who allege that they obtained hydrochinon on fusing monochlor-phenol with hydrate of potassa.

On Oxethenanilin.—E. Demole.—By allowing ethylen-oxide to act upon an equivalent quantity of anilin in a sealed tube the author obtained a new base, $C_8H_{11}NO$. It consists of—

Carbon	70·08
Hydrogen	8·31
Nitrogen	10·64

This base is less mobile than anilin, colourless when recently prepared, sparingly soluble in water, alcohol, and ether, but readily in chloroform. The aqueous solution takes a green colour with solution of hypochlorite of lime.

Examination of Human Bile.—Oscar Jacobsen.—The bile appeared as a clear greenish brown-yellow, and perfectly neutral liquid. The specific gravity at 17·5° C. ranged from 1·0105 to 1·0107, and the percentage of solid matter was from 2·24 to 2·28. Only in the first days traces of albumenoid bodies and of leucin were found in the bile. Grape-sugar and urea were not present. Of the better known bile pigments bilirubin and biliverdin were found. The mineral ingredients were:—

	Percentage of the Ash.	Percentage of Dried Bile.
KCl	3·39	1·276
NaCl	65·16	24·508
CO_3Na_2	11·11	4·180
PO_4Na_3	15·90	5·984
$(PO_4)_2Ca_3$	4·44	1·672
	100·00	37·620

Very small quantities were found of iron, silicic acid, and magnesia. Traces of copper were sought for on three occasions, and were found on each. The copper was only in the portion of the bile insoluble in alcohol. *Organic Constituents*—3·14 per cent of the dried residue dissolved in ether—

Chloleserin	2·49
Unsaponified fats, with a little oleate of soda	0·44
Leeithen	0·21
	3·14

The organic substances insoluble in ether and alcohol formed—Of the solid residue, 10·0. The alcoholic extract—Glycoholate of soda, 44·8; palmitate and stearate of soda, 6·4. On the prolonged boiling of human bile with hydrate of baryta trimethylamin was invariably obtained, whence cholin may be regarded as a normal constituent of human bile.

Silico-Acetic Acid and its Ether.—A. Ladenburg.—The ether has the formula $SiCH_3(OC_2H_5)_3$. Its specific gravity at 0° = 0·9283. It is soluble in alcohol, insoluble in water, but is gradually decomposed thereby. The density of its vapour in toluidin vapour amounts to 170·8, H being calculated = 2; and its molecular weight = 178. In other respects it is similar to ortho-silico-propionic ether.

Oxymethan-Sulphonic Acid, and Oxymethan-Disulphonic Acid.—Max Müller.—The author has obtained the two acids, and gives the structural formulæ.

Composition of Cascarillin.—C. Mylius and E. Mylius.—Cascarillin and ricinin are decidedly unlike. Ricinin is a well marked base, whilst cascarillin is indifferent to alkalies and acids, and contains no nitrogen. Its formula is $C_6H_9O_2$, and its composition—

Carbon	63·71
Hydrogen	7·97
Oxygen	28·32
	100·00

Product of the Oxidation of Caryophyllin.—E. Mylius.—The author obtained and examined caryophyllinic acid, $C_{20}H_{32}O_6$, composed of—

Carbon	65·22
Hydrogen	8·69
Oxygen	26·09
	100·00

The salts of soda, silver, and baryta were likewise prepared and analysed.

On Nitro- and Amido-Benzylamid.—Julius Strakosch.—The author has prepared and analysed the hydrochlorate of secondary nitro-benzylamin, the free base itself, $C_{14}H_{13}N_3O_4$; tertiary nitro-benzylamin, $C_{21}H_{18}N_4O_6$; secondary amido-benzylamin, the hydrochlorate of which is $C_{14}H_{20}N_3Cl_3$; tertiary amido-benzylamin, $C_{21}H_{24}N_4$; hydrochlorate of nitro-benzyl-phenylamin, $C_{13}H_{13}N_2O_2Cl$; and hydrochlorate of amido-benzyl-phenylamin,—

$$C_{13}H_{16}N_2Cl_2.$$

On a Polymeric Modification of Isobutyl Aldehyd.—G. A. Barbaglia.—The author acted upon isobutyl aldehyd with bromine and iodine, and obtained polymerised modifications melting at 60° C., very permanent, reducing salts of silver slowly without forming a silver mirror. The variety polymerised by bromine gave—

Carbon..	66·666
Hydrogen	11·111
Oxygen	22·223
	100·000

It is probably a tri-molecular modification of isobutyl-aldehyd.

Action of Pyromellithic Acid upon α-Naphthol.—Julijan Grabowski.—The following is a conspectus of the substances formed and examined :—

No. 1. Di-α-naphthol-pyro-mellitheinic acid —
$$C_{10}H_6O_8+2C_{10}H_8O-2H_2O=C_{30}H_{18}O_8.$$
No. 2. Tri-α-naphthol-pyro-mellitheinic acid—
$$C_{10}H_6O_8+3C_{10}H_8O-3H_2O=C_{40}H_{24}O_8.$$
No. 3. Tri-α-naphthol-hemianhydrid-pyro mellitheinic acid—$C_{10}H_6O_8+3C_{10}H_8O-4H_2O=C_{40}H_{22}O_7$.
No. 4. α-, β-, and γ-tetra-α-naphthol-hemiar hydrid-pyro-mellitheinic acid—
$$C_{10}H_6O_8+4C_{10}H_8O-5H_2O=C_{50}H_{28}O_7.$$
No. 5. Pyro-mellithein-tetra-α-naphthol-anhydrid—
$$C_{10}H_6O_8+4C_{10}H_8O-6H_2O=C_{50}H_{26}O_6.$$
No. 6. Phthaleindi-α-naphthol—
$$C_8H_6O_4+2C_{10}H_8O-2H_2O=C_{28}H_{18}O_4.$$
No. 7. Phthaleindi-α-naphthol-anhydrid—
$$C_8H_6O_4+2C_{10}H_8O-3H_2O=C_{28}H_{16}O_3.$$
No. 8. Carboneindi-α-naphthol-anhydrid—
$$CO(OH)_2+2C_{10}H_8O-3H_2O=C_{21}H_{12}O_3.$$

Combinations of Chloral with Sulphuric Acid.—Julijan Grabowski.—A compound of this nature is obtained by the action of anhydrous sulphuric acid upon chloral. It has the formula $C_{10}H_9Cl_{15}S_3O_{16}$. It is the most permanent of all the sulphuric compounds of chloral. If cautiously heated with alcohol it dissolves and crystallises out unchanged on cooling.

Reply to Coupier's Reclamation on the Preparation of Magenta without Arsenic Acid.—A. Brüning.—The author declares that his procedure, though founded on the same reaction, is essentially different from that of Coupier, producing magenta at a far lower price, and of much superior quality.

Laws Governing the Molecular Rotatory Power of Tartaric Acid and its Salts.—H. Landolt.—This paper is not adapted for abstraction.

Nature of the Elements.—G. A. Groshans.—A mathematical paper, likewise not suited for abstraction. The author concludes with the remark that if the specific volumes of two bodies which differ from each other by an atom CH_2, or an atom of any other element or other atomic group from their respective boiling-points, remainders are occasionally obtained which may be considered as approximately equal.

Benzylised and Dibenzylised Acetic Acid.—Lydia Sesemann.—The authoress, an *alumna* of the University of Zurich, has obtained benzyl-acetic acid, $C_9H_{10}O_2$, and dibenzyl-acetic acid, $C_{16}H_{16}O_2$, and is at present engaged with studying the most important derivatives and metamorphoses of the latter.

Examination of Certain Bodies of the Camphor Group, Carvol and Carvacrol.—Aug. Kekulé and A. Fleischer.—Carvol is obtained by fractional distillation of the oil of carraway, and boils at 224·5°. It was converted into carvacrol by the action of ortho-phosphoric acid. It boils at 232° to 232·5°, and is isomeric with thymol. Neither carvol nor carvacrol yields any well-characterised product with oxidising agents, except oxalic acid. Perchloride of phosphorus acts upon carvacrol in the same manner as upon the more simple phenols. The sulphacid of carvacrol is solid and crystalline, and its salts can be obtained in fine crystals.

On Bromo-Campho-Carbonic Acid.—J. de Santos e Silva.—The action of bromine upon campho-carbonic acid is very energetic, hydrobromic acid being evolved. If the mixture heats decomposition takes place, but if the temperature is kept down a crystalline yellowish product is obtained, perfectly soluble in dilute soda or potassa-lye. From this solution hydrochloric acid throws down monobromo-campho-carbonic acid as a white powder,—

$$C_{11}H_{15}BrO_3.$$

On Terebic and Pyroterebic Acids.—W. Carleton Williams.—Pure terebic acid melts at 175°, whilst Caillot gives 168°. The statement of Svanberg that terebic acid yields both terebates, $C_7H_9MO_4$, and diaterebates, $C_7H_{10}M_2O_3$, was confirmed. Pyroterebic acid was obtained by the dry distillation of terebic acid; it boils at 210°. With bromine it combines to form bibromocapronic acid.

On Ethyl-Crotonic Acid.—W. Petrieff.—Ethyl-crotonic acid is isomeric with pyroterebic acid. On fusion with potassa it is split up into acetic acid and butyric acid, the latter probably the isobutyric.

Derivatives of Normal Propylic Alcohol.—H. Rœmer.—The author, acting on propylic alcohol with phosphene gas, obtained chloro-carbono-propylic ether, and a liquid heavier than water, burning with a green flame, and giving off a pungent odour. Its formula is $C_4H_7ClO_2$.

Action of Bisulphide of Carbon upon Para-Nitranilin.—A. Brückner.—A preliminary communication.

Certain Homologues of Oxaluric Acid.—W. H. Pike.—This has already appeared in our columns.

New Synthesis of Propionic Acid.—J. H. van Hoff.—The acid was found amongst the products obtained by exposing to heat oxalate of potassa and dry sodium ethylate.

Contributions to the History of the Polythionic Acids.—W. Spring.—The author has studied the action of chloride of sulphur upon the sulphites. Among the results were trithionate of potassa, and hyposulphite of potassa.

Certain Derivatives of Benzophenon.—Julius Beckmann.—On treating benzophenon with fuming sulphuric acid the author obtained a body, $C_{12}H_8SO_3$. Its lead and baryta salt were formed and analysed, and it was submitted to the action of pentachloride of phosphorus, yielding a new body not yet fully examined.

Cyan Derivatives of Acetaldehyd and Aldehyd-Ammonia.—F. Urech.—By mixing equivalents of aceton, CNK and CNOK, with acids acetonyl-urea was obtained. To prepare lactyl-urea instead of the aldehyd, which easily becomes resinous in a basic liquid, its ammonia compound was used. In this manner lactyl-urea was prepared, which the author had previously obtained from CNOH and alanin.

On Nitronaphthol.—R. Biedermann.—The author has examined the compounds of nitronaphthol with

potassium, sodium, ammonium, barium, calcium, lead, and silver. A bromated substitution product, bibromnaphthol, $C_{10}H_5Br_2OH$, was also obtained and analysed.

A Reply to Barbaglia.—G. Kraemer.—A controversial paper on isobutylic aldehyd and isobutylic alcohol.

New Resin Acid—the Podocarpinic.—A. C. Oudemanns, jun.—The composition of the acid may be expressed as $C_{17}H_{22}O_3$. It fuses at 187° to 188°, and is not decomposed below 330°. Several of its salts and its nitro and sulpho derivatives have been examined. The acid was obtained from a kind of resin extracted from a Javanese tree, *Podocarpus cupressina*.

Constitution of Podocarpinic Acid.—A. C. Oudemanns, jun.—A continuation of the foregoing paper.

Base from Nitrobenzanilid.—H. Hübner and H. Retschy.—The authors have examined the salts of the base $C_{13}H_{10}N_2$.

Javanese Cinchona Barks.—Jul. Jobst.—A paper chiefly of pharmaceutical and botanical interest.

Annalen der Chemie und Pharmacie, band clxviii., heft 2 and 3 (Neue Reihe, band xcii., heft 2 and 3), August 30, 1873.

Preparation of the Sulpho-Acids.—W. Hemilian.—The author modifies Strecker's method by operating upon the haloid derivatives of organic compounds with the sulphite of ammonia instead of the sulphite of potassa.

On certain Haloid Derivatives of Toluol.—Dr. E. Wroblewsky.—The author describes first the bromated, and then the chlorated, compounds of toluol. He has formed and examined—Aceto-meta-brom-para-toluidin—

$$C_6H_3Br_m.(CH_3)NH(C_2H_3O).$$

Meta-brom-para-toluidin, $C_6H_3Br(CH_3)NH_2$; with its nitrate, $C_7H_6BrNH_2NHO_3$; its hydrochlorate—

$$C_7H_6BrNH_2HCl;$$

its acid oxalate, $C_7H_6BrNH_2C_2H_2O_4$; its acid sulphate, $C_7H_6BrNH_2H_2SO_4+H_2O$. Meta-brom-toluol—

$$C_6H_4Br(CH_3);$$

with its lime salt, $(C_7H_4BrO_2)_2Ca+3H_2O$; and its baryta salt, $(C_7H_4BrO_2)_2Ba+4H_2O$. He has further obtained—The hydrochlorate of brom-toluidin; the nitrate; the baryta salt, $(C_7H_4BrO_2)_2Ba+4H_2O$. The author next describes the reactions of—Diazo-meta-brom-toluol; meta-brom-para-iodo-toluol, $C_6H_3I_p Br_m.CH_3$; the nitro-para-iod-meta-brom-toluol, $C_6H_2NO_2.I_p Br_m.CH_3$. He examines the preparation of meta-brom-toloul on the decomposition of diazo-meta-brom-per-bromide, and the preparation of meta-brom-toluol from ortho-toluidin; aceto-meta-brom-ortho-toluidin—

$$C_6H_3Br_m(CH_3)NH(C_2H_3O).$$

Meta-brom-ortho-toluidin, $C_6H_3Br_m(CH_3)NH_2{}_o$; its hydrochlorate, $C_7H_6BrNH_2HCl$; nitrate—

$$C_7H_6BrNH_2NHO_3;$$

and sulphate, $(C_7H_6BrNH_2)_2H_2SO_4$. Meta-brom-ortho-iod-toluol, $C_7H_6Br_mI_o$; nitro-meta-brom-ortho-iod-toluol, $C_7H_6NO_2Br_mI_o$; meta-brom-ortho-cresol—

$$C_6H_3Br_m(HO)_o CH_3.$$

The sulpho derivatives of meta-brom-toluol; with the α barytic salt, $(C_7H_6Br_mSO_{3\,o})_2Ba+H_2O$; the potash salt; the β barytic salt, $2[(C_7H_6Br_mSO_{3\,o})_2Ba]+3H_2O$; the β lead salt, $(C_7H_6Br_mSO_{3\,o})_2Pb+3H_2O$; the β lime salt, $2[(C_7H_6Br_mSO_{3\,o})_2Ca]+5H_2O$; the β potassic salt, $C_7H_6Br_mSO_{3\,o}K$. The ortho-sulpho-meta-brom-toluolic acids have the constitution 1:2:3 and 1:3:6, and both, therefore, yield salicylic acids. The γ barytic salt—

$$2[(C_7H_6Br_mSO_3)_2Ba]+5H_2O;$$

nitro-β-meta-brom-ortho-sulpho-toluolate of baryta—

$$2[(C_7H_5NO_2.Br_mSO_{3\,o})_2Ba]+7H_2O;$$

and the lead salt $[C_7H_5Br_m(NO_2)SO_{3\,o}]_2Pb+3H_2O$; and the corresponding lime salt—

$$2[(C_7H_5Br_m(NO_2)SO_{3\,o})_2Ca+9H_2O.$$

Meta-brom-toluol was found to yield two nitro-derivatives—α, solid, and β, liquid. The author next examines—Ortho-brom-toluol and its derivatives, particularly ortho-brom-toluol and the results of its oxidation; dibrom-toluol; the preparation of ortho-brom-toluol from meta-toluidin; ortho-brom-meta-toluidin, with its nitrate. He next investigates para-brom-toluol and its derivatives—α solid para-brom-ortho-nitro-toluol; β liquid para-brom-meta-nitro-toluol; α-para-brom-ortho-toluidin; β-para-brom-meta-nitro-toluidin, with the α and β nitrates. The author remarks that the theory of the aromatic compounds indicates the existence of six isomeric dibrom-toluols. He next proceeds to the tribrom-toluols, and to the chloric substitution-products of the isomeric toluidins and of their derivatives.

On Selenic Acid and the Seleniates.—Dr. v. Gerichten.—In this paper the author gives a simple and certain method for the preparation of hydrous selenic acid. His attempt to produce the anhydrous acid yielded a mixture of the substance sought and of selenious acid. He finds it possible to prepare alums in which selenic acid replaces either the sulphuric acid in combination with potassa, or that united to alumina. The same result may be attained with the double salts of the formula—

$$m_2RO_4.MRO_4+6H_2O.$$

It is possible in all these salts to replace the sulphuric acid, molecule for molecule, by selenic acid, and the prodigious mass of salts thus obtained are all isomorphous with the two extreme members of the series—the pure sulphuric and the pure selenic double salts.

Action of Trisulpho-Carbonate and Sulpho-Carbaminate of Ammonia upon Aldehyds and Aceton.—E. Mulder.—Acetonin was obtained by the action of ammonia upon aceton, and subsequent addition of aqueous oxalic acid, and its trisulpho-carbonate was then formed and examined.

New Formation of Ortho-Toluilic Acid.—R. Fittig and W. Ramsay.—This paper is not suitable for abstraction.

On Meta-Toluilic Acid.—C. Bœttinger and W. Ramsay.—The authors find that what Ahrens and Tawildarrow took to be pure meta-toluilic acid was a mixture of this salt with more or less para-toluilic acid.

MISCELLANEOUS.

Prize List of the Société Industrielle de Mulhouse.—The following is a translation of the list of prizes offered by this Society; with very few exceptions, they are open to general competition. They will be decided in May, 1874. There are three classes of medals, all of bronze, but differing in size:—Medals of honour; 1st class medals; and 2nd class medals.

GENERAL PRIZES.

CHEMICAL ARTS.

1. An essay on the theory of the manufacture of Turkey red. (*1st class medal.*)

2. A theoretical essay establishing the chemical constituents of the substance, or substances, which accompany alizarin in garancin, and which, in concert with this colouring matter, produce the dyes called garancin. (*1st class medal.*)

3. For the manufacture and delivery to the calico manufactories of Alsace of an artificial product, capable of entirely replacing the colouring matter of garancin, and which, both as regards price and quantity is fitted for industrial purposes. (*Medal of honour.*)

4. For the preparation of vivid lakes from garancin, both red and violet. (*Medal of honour.*)

5. For a substance which can be used to thicken colours, sizes, or dressings, and which will replace, at a saving of at least 25 per cent, all the substances hitherto employed for these purposes. (*Medal of honour.*)

6. For a substance which can replace the dry albumen of eggs in the manufacture of printed calicos, and give a large saving on the price of albumen. (*Medal of honour.*)

7. For colourless albumen from blood, which will not colour by evaporation. (*Medal of honour.*)

8. For an important improvement in the bleaching of wool or silk. (*Medal of honour.*)

9. For a method of bleaching which will remove from unbleached cotton all amylaceous substances, without injuring the tissue, and without any great increase of expense. (*Medal of honour.*)

10. Essay on the employment of resins in the bleaching of cotton fabrics. (*1st class medal.*)

11. For an ink for marking cotton fabrics intended to be dyed with plain grounds, red, puce, and other dark colours. This ink must show plainly after undergoing all the operations required for these dyes. (*1st class medal.*)

12. For an essay on the action of different kinds of cotton under processes for bleaching and colouring. (*Medal of honour.*)

13. For a blue which can be used for dyeing wools blue, and which will resist the action of steaming and light. (*1st class medal.*)

14. For any improvement in chemical products as regards purity and concentration—acids, alkalies, soaps, colouring matters, and decoctions. (*1st class medal.*)

15. For one or other of the following colours:—Metallic red, dark metallic green, metallic violet, garnet, and a shade of the series from pearl grey to dark, capable of being printed by rollers with albumen as thickening. (*Medal of honour.*)

16. For a theoretical and practical essay on cochineal red. (*Medal of honour.*)

17. For a transparent green, resisting light and soap, whose brightness, intensity, applicability to cotton fabrics, and price, render its use possible in manufactures. (*Medal of honour.*)

18. For an essay on this question: Can indigotin be recovered from its sulphuric acid compounds? (*2nd class medal.*)

19. For the first who delivers to the calico manufactories of Alsace an artificial product replacing advantageously the blue colouring-matter of indigo. (*Medal of honour.*)

20. For the first who delivers to the calico manufactories of Alsace an artificial product replacing advantageously the sulphuric acid derivatives of indigo. (*1st class medal.*)

21. For a new process of fixing, by printing, anilin colours in a more complete way than by albumen. (*1st class medal.*)

22. For an anilin black, soluble in any vehicle, which can serve as a dye, and can resist the action of light and soap, as well as true anilin black. (*Medal of honour.*)

23. For a new black of the same intensity and the same solidity as anilin black, which will not weaken the fabric, and will bear contact with all other colours, especially those mixed with albumen, without itself injuring the shades with which it is associated. (*1st class medal.*)

24. For an essay on the composition of anilin black. (*Medal of honour.*)

25. For a scarlet red susceptible of applications similar to those of the anilin colours, which will not be more fugitive than them, and not dearer than a cochineal crimson. (*Medal of honour.*)

26. For any reproduction, by an artificial or natural alkaloid, of the reactions which, with aniline, toluidine, naphthylamine, produce red, blue, green, and black. The essay should be accompanied with samples, and will receive a prize even if industrially inapplicable. (*Medal of honour.*)

27. For a method of increasing the solidity of artificial colouring matters. (*Medal of honour.*)

28. For a certain and practical method of bringing anilin black, immediately after printing, to the maximum of oxidation, without having recourse to ageing, and without damaging the fabric or injuring the metal employed for printing. (*1st class medal.*)

29. For the introduction into manufactures of calicos printed in a new colour, which is developed and fixed under conditions analogous to those under which anilin black is produced; which shall also be impervious to air and light, and resist the action of soap, alkalies, and acids. (*Medal of honour.*)

30. For a metallic alloy or other substance fitted to serve for doctors, and which unites to the elasticity and hardness of steel the property of not causing any chemical action in the presence of acid colours, or colours charged with certain metallic salts. (*Medal of honour.*)

31. For any great improvement in the engraving of cylinders. *Medal of honour or 1st class medal.*)

32. For the best practical manuals on one or other of the following subjects:—(1). Engravingprinting cylinders. (2). Engraving printing blocks. (3). Bleaching cotton, wool, wool and cotton, silk, hemp, and linen. (*Medal of honour of the 1st or 2nd class, according to the merit of the essay.*)

33. For an essay on this question: At what degrees of damp and heat does the decomposition of mordants act with most rapidity and most advantage? (*1st class medal.*)

34. For a new cylinder machine, able to print at least eight colours at a time, and offering some advantages over those at present employed. (*Medal of honour.*)

35. For introducing or manufacturing in Alsace cylinders of cast-iron, covered with copper by electro-plating, which are to be used in printing calicos. (*Medal of honour.*)

36. For a series of new colours, with metallic bases, unchangeable by the action of air and light. These colours, specially intended for use as plain colours, must be fixed otherwise than by albumen, and be able to bear washing. (*Medal of honour.*)

37. The best system of vats for dyeing and soaping. (*1st class medal.*)

38. For the discovery or introduction of a method useful in the manufacture of printed fabrics or chemical products. (*Medal of honour of the 1st or 2nd class.*)

39. For a method of recovering the sulphur contained in hydrosulphuric acid. (*1st class medal.*)

40. For an apparatus transmitting thermometrical indications to a distance. (*1st class medal.*)

41. For an apparatus marking automatically the temperature and the hygrometrical state of the air in the drying-houses of calico factories. (*1st class medal.*)

42. For a new method of treating the different kinds of oil used for lubricating machines. (*Medal of honour.*)

43. For an essay on the relative inflammability of the animal, vegetable, and mineral oils used in workshops for lubricating machines. (*1st class medal.*)

44. For an essay indicating some process by which mineral oils may be rendered less inflammable while their lubricating properties are preserved. (*Medal of honour.*)

45. For the production of carminic acid by synthesis. (*Medal of honour.*)

46. For introducing into manufactures artificial orcin. (*Medal of honour.*)

47. For the preparation of vermillion on cotton fabrics. (*Medal of honour.*)

48. For a blue, analogous to ultramarine as to shade and solidity, to be fixed on fabrics of cotton by a chemical process, without the help of albumen or any other thickening substance producing adhesion by coagulation. (*Medal of honour.*)

49. For a practical method of extracting from garancin the orange-red colouring matter, the price of which will admit of the use of this product in printing cotton fabrics. (*Medal of honour.*)

50. For the first delivery to the cotton factories of Alsace of a pipe-clay, either natural or artificial, in impalpable powder, which will serve to thicken the colours used for cylinder printing; it must be entirely free from the hard and sandy substances which nearly always accompany it. (*2nd class medal.*)

51. For the best system of vats for dyeing. (*1st class medal.*)

52. For the production of carminic acid by synthesis.

MISCELLANEOUS PRIZES.

31. For a new method of treating the different kinds of oil prope for lubricating machines. (*Medal of honour.*) (See prize No. 42 for Chemical Arts.)

37. For a new machine for cylinder printing, capable of printing at least eight colours at a time, and offering advantages superior to those now in use. (*Medal of honour.*) (See No. 34 of the Chemical Arts' prizes.)

38. For an alloy of metal, or other substance, fitted to replace advantageously, under all circumstances, the gun-metal employed in the construction of machines. (*1st class medal.*)

42. For the invention and application of a pyrometer capable of gauging the temperature of the gaseous products of the coal burned under steam generators. (*Medal of honour.*)

52. For a new burner for coal-gas, utilising more thoroughly than known burners the light produced by combustion; it must be simple and cheap, and grounded on a new principle. (*Medal of honour.*)

53. For a simple automatic method of regulating the admission of steam into bleaching or dyeing vats, so that the consumption of steam may always correspond with the desired result. (*Medal of honour.*)

PRIZES OF THE COMMITTEE OF COMMERCE.

1. For an essay treating of the different uses of alcohol in the industrial arts and pointing out a new and practical way of "denaturalising" this liquid. The process indicated must reconcile the interests of industries with the demands of the excise. (*Medal of honour.*)

6. For researches made in China or Japan with the object of procuring from these countries raw material which will save at least 20 per cent in producing certain chemical products, such as tartaric acid, citric acid, borax or boracic acid, &c. (*1st class medal.*)

11. For the person or society which introduces and practises the culture of madder in Algeria. (*1st class medal.*)

COMMITTEE OF PUBLIC UTILITY.

9. For an apparatus to renew the air quickly in the drying-houses used to oxidise anilin black. (*1st class medal.*)

PAPER INDUSTRY.

1. For the production and use in France of a white pulp produced by the chemical disintegration of wood. The prime cost of this paper-pulp should be such that it can be used either alone or mixed, and replace rag-pulp advantageously, in white writing paper, or paper for printing of the usual kinds. (*Medal of honour and 4000 francs.*)

2. For the best essay on the bleaching of rags. (*Medal of honour.*)

3. For the best essay on the sizing of paper. (*1st class medal.*)

4. For a method of neutralising or diverting the electricity which is often injurious to the manufacture of paper. (*1st class medal.*)

5. For a statistical essay on the condition of the paper industry in the principal states of Europe (France, England, Germany, Italy, Prussia, Spain, and Belgium) and in the United States of America. (*1st class medal.*)

South London School of Chemistry and Pharmacy. *Director*—Dr. JOHN MUTER, F.C.S.

Hours of Lecture for Session 1872-73:—

Chemistry (Inorganic)	10 a.m.	Materia Medica	4 p.m.
(Organic)	2 p.m.	Pharmacy	2 p.m.
Botany (Structural) ..	11 a.m.	Classics (Junior)	9 a.m.
„ (Systematic) ..	3 p.m.	„ (Senior)	4 p.m.

Laboratory open for Practical Chemistry from 10 till 4.

This School affords the most eligible opportunities for obtaining at once a rapid, complete, and practical knowledge of the subjects taught. All the fees are perpetual until the examination in view is passed, without reference to time. Country Students visiting London are placed in Lodgings registered by the Secretary, where no impositions are permitted to be practised, and where the prices are all on a fixed moderate scale. For terms, apply to the Director, or to

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THE CHEMICAL NEWS.

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THE POLLUTION OF RIVERS' BILL.

We were all perfectly aware, years ago, that the condition of most English rivers is a danger and a disgrace. Nevertheless, unwilling or unable to trust our own eyesight and our own noses, there was sent out a Royal Commission of inquiry, to whom, for repeating some of the stalest possible truisms have been given—not the proverbial "pinch" due to the bringer of old news. The requirements of red tape having been thus scrupulously fulfilled, we are at liberty to believe that our streams are foul, and to legislate for their restoration to a state of natural purity. Judging from the bill before us there is imminent danger that the remedy may be worse than the disease—that a law may be enacted which will hamper and annoy our manufacturers, give rise to an abundant crop of litigation, and yet decidedly fail to effect the reform desired.

The Select Committee of the Lords appointed to reconsider the first draught of the Bill have sinned against better light and knowledge. In addition to the Reports of the Rivers' Pollution Committee—costly at least, if not valuable—and to its natural appendix, the evidence of Dr. Frankland, they had the independent testimony of Dr. Lyon Playfair; of Mr. J. C. Stevenson, M.P., the representative of the Alkali Manufacturers' Association; of Mr. R. Nichols, an eminent tanner, of Leeds; of Mr. J. Botterill, who may be considered as the spokesman of the Yorkshire dyeing interest; of Mr. R. B. Sanderson, the representative of the coal trade of Northumberland and Durham; of Mr. Ball, Mayor of Newcastle; of Mr. J. Evans, F.R.S., on behalf of the paper trade; of Mr. Crookes; besides other witnesses of less moment. Yet, after hearing this evidence, the Committee have persisted in including as their definition of "polluting liquids"—the entrance of which into any stream is declared penal—the notorious "recommendations" of the Rivers' Pollution Commission! The only modifications adopted, in order to bring these proposals into some little harmony with the necessities of the situation, are the introduction of a clause prohibiting liquids which display a film of petroleum on their surface, and the omission of the clause forbidding all fluids which show a distinct colouration in layers of 1 inch deep, and of the exclusion of any liquid holding in suspension 3 parts by weight of dry mineral matter in 100,000.

The objections against this code, which must by this time be familiar to almost every man of education in the kingdom, have never been faced, least of all by its authors. We have asked—On what principle have the numerical limits fixed in this document been selected? Silence has shown that with the Commissioners and their friends "reasons are not as plentiful as blackberries." We have shown that the term "organic nitrogen" includes substances highly dangerous, and bodies, like urea, which are no more to be dreaded than pre-formed ammoniacal salts, or than the nitrates and nitrites in the effluent water from an irrigation-farm. No one has come forward to defend the classification we have attacked. We have pointed out that, whilst (Recommendations, §4) arsenic is rigorously excluded, yet copper, lead, and chrome are, by §3, placed on the same footing as such comparatively harmless matters as manganese, iron, and aluminium. To this inconsistency Mr. Crookes, in his evidence before the Select Committee of the House of Lords, called special attention: "There is no difficulty in keeping arsenic out; but it is strange that whilst arsenic is specially provided against, other metals which are almost as injurious, such, for instance, as copper, lead, and chromium, are allowed to slip through. Those three metals ought to be looked after as sharply as arsenic." Dr. Lyon Playfair also recommends the exclusion of copper and lead. Yet this advice has been strangely ignored. So strange is the above omission, and so obstinately is it persevered in, that we cannot help pointing to the fact that certain mountain-waters contain traces of copper and lead, and that any very stringent law against the presence of these metals might be hereafter inconvenient to all who wish to force these waters upon the Metropolis.

But without further criticising errors of detail, so open and palpable that those who cling to them have some claim to a place amongst psychological curiosities, let us at once go to the root of the matter. This was pointed out by Mr. Crookes in his evidence: "The bulk of the liquid sent into a river is quite as important as the degree of its pollution. If the river is a tolerably large one a thousand gallons or so of most offensive liquid would be lost in it—it would be of no consequence whatever;—whilst one or two million gallons of a much less impure liquid would really pollute the river more. The bulk of the polluting liquid in comparison with the bulk of the river itself I do not think is mentioned at all (in the Recommendations). There ought to be some stipulation as to the proportion which the polluting liquid should bear to the river into which it flows."

Again: "Suppose a manufacturer to be situated at the head of the stream, where it is of consequence that nothing shall go in which will in the slightest degree deteriorate that stream, and suppose he throws in a liquid which will not quite come up to these requirements,—the Act can be easily evaded by pumping a little more of the pure river water through his works, thus diluting his liquid down to the proper point and sending that into the river. But exactly the same manufacturer, fifty miles below on the stream, after the river has passed through many towns, and taken the drainage of a large district and of many manufactories, if he throws into the same river the same kind of liquid, will not be able to evade the Act in that way, because the liquid that he would throw into the river would be in some respects purer than the river itself; and he would not, therefore, be able to dilute his waste liquid with a purer water. It appears, therefore, that where the requirements of the Act ought to be carried out stringently evasion would be easy, but where it is of comparatively little consequence to carry out those requirements evasion would be impossible, because the river would be worse than the liquid which was put into it."

In reply to further questions, Mr. Crookes states: "I would therefore say that no person should send into a river water which is less pure than the water of the river at the place at which it goes in."

Again: "If the river contained 100 grs. per gallon of impurity, and I turn into it water containing 90 grs. per gallon of impurity, although that is a very impure liquid, I am doing the river good rather than harm."

This evidence points out the necessity of having, not one hard and fast line for the whole kingdom, but an "elastic test" which will gradually become more and more stringent. Surely that practical common sense, on which Englishmen were wont to pride themselves, will never allow us to punish a man for "polluting" a river when he is actually improving it!

"At Leeds," says Mr. Crookes, "a manufacturer might dip a bucket into the river, and throw it back again, and he would be in that way throwing water into the river, which would not come up to the requirements of this Act. He might simply pump the river water through his works, without doing anything with it, and he would be liable to be fined."

To do the Committee of the Lords justice, the absurdity which Mr. Crookes here points out was too great for them to defend, and accordingly in clause 4 of the amended Bill we find the following proviso:—"But no person shall be subject to the foregoing penalties if he proves, to the

satisfaction of the court before whom he is tried, that the pollution caused by him to any river or affluent thereto arises from liquid previously taken by him from such river or affluent, and does not come within the definition of polluting liquid contained in the sixth section of this Act, in a greater degree than when the same was so taken by him." The principle being thus established, we may pardon the illogicality of the expression.

Turning to the evidence of Dr. Lyon Playfair, we find that he, also, perceives the fundamental deficiency of the Bill. He suggests provisions against any discharge into a stream of matters which will raise its sum-total of impurities beyond a certain amount. He thinks it necessary "not only to guard the inlets, but to have power also to look at the stream itself, and to see that it is kept pure;" and he indicates an evil to be guarded against, viz., "the practice of flushing out drains at night, when nobody is there to watch the condition of the water."

This suggestion, like those given by Mr. Crookes, has not been adopted. Indeed, it is easy to see that there is a feeling against them. Dr. Frankland, on his second examination, actually says: "The Bill does not apply to rivers; it is not a Bill to test rivers, but to test the discharges into rivers from factories." Dr. Frankland describes the Bill correctly, and gives the very reason why it ought, as it now stands, to be rejected. His motto is evidently "the recommendations, the whole recommendations, and nothing but the recommendations." Less partial judges, however, will probably look on these same "recommendations" merely as a means to an end, and will reject them as ill-calculated for the attainment of that end. We shall return to the consideration of the remaining evidence given before the Committee, and of the amended Bill as it now stands.

ON THE ESTIMATION OF ALUMINA AND IRON IN PHOSPHATES.

By ALEXANDER ESILMAN.

HAVING had occasion to estimate alumina in various native phosphates and artificial phosphatic liquors during the last twelvemonths, I devised the following process, based on an old method, for the separation of iron and alumina. In its present form I do not claim for it scientific accuracy, but where commercially fair results are required in a very short space of time my past experience warrants me in offering it for trial. It is founded on the fact that, in the presence of an excess of hyposulphite of soda and acetic acid, phosphate of alumina precipitates in the tribasic form (Al_2O_3,PO_5) of constant composition at the boiling temperature. The precipitate is mixed with sulphur, easily washed, and on ignition the sulphur burns off, leaving pure phosphate, 122·5 parts of which are equal to 51·5 parts of alumina. Of course the presence of excess of phosphoric acid must be ensured. All our present methods involve the previous separation of the phosphoric acid, necessitating, in most cases, operating on very small quantities, and delicate working; but the one under notice is applicable whatever be the quantities of phosphoric acid, iron, lime, or magnesia, present. I have, in fact, most commonly used it for determining small quantities of alumina in presence of large proportions of phosphoric acid, where the molybdic method proposed by Ogilvie would be almost impracticable.

One defect of it is the invariable precipitation of traces of iron with the aluminic phosphate, but the following test results, performed under very varying circumstances, show that its accuracy thereby is not materially impaired. The solution ought to be dilute and not very hot, and should contain a tolerable amount of free acid. An excess of hyposulphite of soda is added, then acetic acid in liberal excess. Ten or fifteen minutes are allowed for the complete deoxidation of the iron, and then the solution is boiled for about the same length of time. The filtration and washing of the precipitate are done hot and rapidly, and, after drying, the latter is ignited in a porcelain crucible.

Taken.	Found.
8·76 grs. PO_5	
5·56 ,, Fe_2O_3	3·05 grs. Al_2O_3
3·06 ,, Al_2O_3	
17·52 grs. PO_5	
2·78 ,, Fe_2O_3	1·54 grs. Al_2O_3
1·53 ,, Al_2O_3	
17·52 grs. PO_5	
11·14 ,, Fe_2O_3	1·53 grs. Al_2O_3
1·53 ,, Al_2O_3	
8·76 grs. PO_5	
2·78 ,, Fe_2O_3	1·52 grs. Al_2O_3
1·53 ,, Al_2O_3	
17·52 grs. PO_5	
5·57 ,, Fe_2O_3	1·505 grs. Al_2O_3
1·53 ,, Al_2O_3	
35·04 grs. PO_5	
22·28 ,, Fe_2O_3	1·54 grs. Al_2O_3
1·53 ,, Al_2O_3	
17·52 grs. PO_5	
11·14 ,, Fe_2O_3	1·54 grs. Al_2O_3
1·53 ,, Al_2O_3	
17·52 grs. PO_5	
5·57 ,, Fe_2O_3	1·54 grs. Al_2O_3
1·53 ,, Al_2O_3	
200 ,, NH_4Cl	
17·52 grs. PO_5	
5·57 ,, Fe_2O_3	1·53 grs. Al_2O_3
1·53 ,, Al_2O_3	
50 ,, $CaOCO_2$	
17·52 grs. PO_5	
5·57 ,, Fe_2O_3	1·53 grs. Al_2O_3
1·53 ,, Al_2O_3	
100 ,, $MgOSO_3+7HO$	

The iron can be determined in the filtrate from the phosphate of alumina, after decomposition of the hyposulphite, by boiling with excess of hydrochloric acid; but I prefer employing a separate portion for that object. Having experienced an unexpected difficulty in reducing the peroxide by metallic zinc or protochloride of tin, I employ an excess of sulphide of ammonium for that purpose; the excess is decomposed by hydrochloric acid, and the sulphuretted hydrogen is easily and completely driven off by ebullition. This plan is more expeditious than when zinc is used, and more accurate than the tin method.

I have employed this process also for the rapid determination of phosphoric acid in presence of iron and alumina, especially in native phosphates of alumina, and hope to speak favourably of it some day.

ON CONDUCTION OF HEAT IN CRYSTALS.

BY the numerous experiments made by De Senarmont in 1847, it was proved that heat is not always propagated, in crystals, at the same rate in all directions. Suppose a centre of heat in the middle of a crystal. If the crystal's symmetry is of the regular system, the iso-thermal surfaces are concentric spheres, but crystals of the dimetric and hexagonal systems conduct equally only in directions perpendicular to the principal axis, so that in such crystals the iso-thermal surfaces are ellipsoids of revolution round the axis; while crystals belonging to any of the remaining systems conduct unequally in all directions, so that in them the iso-thermal surfaces are ellipsoids with three unequal axes.

These results have since been largely treated from the theoretical point of view. An experimental examination

and extension of them has recently been undertaken by M. Jannettaz, who has observed and measured with the greatest care the iso-thermal surfaces in forty-four mineral species, twenty-six of which had not been previously experimented on. The particulars of this research are given in a recent number of the *Annales de Chimie et de Physique*.

M. Jannettaz employed two different methods—One is an improved form of that of De Senarmont, which, it is known, consisted in taking a very thin plate of the crystal to be examined, boring a hole in it, and coating it with wax; a heated rod was introduced into the hole; the heat was conducted through the plate, melted the wax, and thus showed the iso-thermal figure. Of course, the lateral radiation must be prevented by a screen. The improvements by M. Jannettaz are—That instead of wax he used a fat which melted more readily, that the heating arrangement was more suitable, and that for screen he employed a vessel through which flowed a constant stream of water.

In the second method, the boring of a hole in the plate was dispensed with, as it is apt to break the plate. The source of heat consisted of a small platinum ball, to which were connected the ends of two wires from a galvanic battery. The ball was put in contact with the plate; thus the heat-source was reduced to a point, and could be made as weak and as constant as might be desired. The measurement of the axes of ellipses thus obtained was effected by means of a micrometer-screw and telescope.

By these methods, M. Jannettaz obtained, for a large number of substances, numerical values of their conductibility (for heat), which, for these substances, are real characteristic constants; the form of iso-thermal ellipsoid is thus a characteristic indication of the mineral species. In the optical uni-axial crystals, the ellipsoid is sometimes flattened, sometimes drawn out in the direction of length. The latter is the case in quartz, whose ellipsoid is comparatively very long. The proportion of the axis to the radius of the equator is in this ellipse 1·312. It deserves to be noticed that this number is exactly the same as that obtained by De Senarmont, a proof of the great experimental exactness of this experimenter, who wrought with very imperfect instruments. Calc-spar shows also a lengthened ellipse, the proportion between the two axes, however, not exceeding 1·095. Antimony, on the other hand, gives a very oblate ellipse; the radius of the equator is to the axis of rotation as 1·59 to 1. Among the optical bi-axial crystals, mica gives the most distinct ellipsoid, but its appearance varies in pieces from different localities. In the clino-rhombic system, gypsum is well fitted for such experiments, and gives a very distinct ellipse.

Through these measurements, which in themselves, and apart from any theory, are advantageous, as giving new specific constants for a determinate number of mineral species, M. Jannettaz believes he has been able to furnish proof that a common relation exists between the lines of greater and less conductibility and the directions of cleavage. Consider the uniaxial substances. The conductibility is less in the direction of the axis in species with basal cleavage, greater in species with prismatic cleavage. If the cleavage follows the rhombohedral surface, and if the angle which it makes with the principal axis is greater than 45°, the cleavage must be reckoned prismatic; when, on the other hand, the angle is greater than 45°, the cleavage is basal. The theoretical meaning of this law is that heat is better propagated in the direction parallel to the surface of cleavage, than in the direction at right angles to it.

This law is verified for the greater number of substances which were experimented with; a remarkable exception from it, however, is met with in emerald and calc-spar, which, from the nature of their cleavage surfaces, should belong to the class of substances with flattened ellipsoids, and which yet give an elongated ellipsoid. M. Jannettaz calls to mind that, according to M. Fizeau, these two substances, on elevation of temperature, show a contraction in the direction of one of their axes.

For the other crystal systems the law is in general proved, and particularly in the case of mica and gypsum. With both these substances, M. Jannettaz, by boring a hole through them, obtained coloured ellipses, produced from a thin layer of air which penetrates between two laminæ of the substance, their axes corresponding to the thermal axes. In gypsum, which has two unequal surfaces of cleavage at right angles to the easy direction of cleavage, the long axis of the ellipse is, according to M. Jannettaz, a direction of least cohesion, arising from the union of two directions of cleavage; the production of the coloured rings, and the coincidence of their axes with those of the iso-thermal curves thus proves the law.

M. Jannettaz further states his intention to investigate several other questions connected with this subject; especially the hypothesis on crystals enunciated by Bravais, and also the result of De Senarmont's experiments with compressed glass, in which he obtained an iso-thermal ellipsoid with its small axis in the direction of compression.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Bradford Meeting, 1873.

SECTION B.—CHEMICAL SCIENCE.

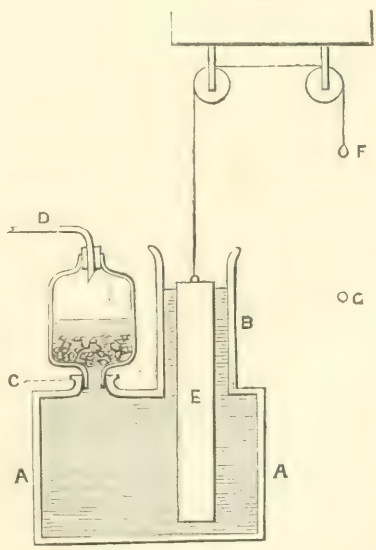
President, Dr. W. J. Russell, F.R.S.

(Continued from p. 198).

"*An Improved Form of Gas Generator*," by C. J. Woodward, B.Sc.

The author referred to various arrangements which had been devised for readily bringing into juxtaposition, or removing from each other, the material required to generate a gas, but stated he did not feel satisfied with any of them, and sought in the apparatus he had made to overcome the objections experienced. Two forms of apparatus had been made. The first, shown in section in Fig. 1, and

Fig. 1.

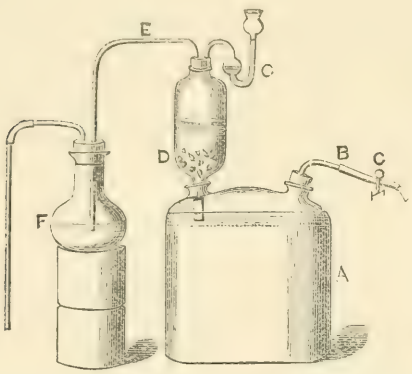


intended for large supplies of gas, consists of a circular stoneware vessel, A A, holding 3 or 4 gallons, and surmounted by a large cylindrical pipe, B. In the top of the vessel is a tubulure, C, to which is fitted a glass cylinder containing the granulated zinc or other gas-generating

material. To the opening of the upper end of the glass cylinder is attached a cork and the delivery tube, D. A plug, F, can be raised or lowered by means of a cord, which, passing over pulleys, terminates in a ring, F. It will readily be seen in what way the apparatus is used. As seen in the figure, the plug, E, is immersed in the acid, with which the stoneware jar is filled, and the liquid has risen by displacement into the glass cylindrical vessel coming in contact with the gas-generating material, when of course the evolution of gas goes on. When it is desired to stop the flow of gas, the plug, E, is raised, the ring, F, being slipped over the stud, G. The acid now retreats from the glass cylinder, and the gas-generating material is left dry. At any time, then, when gas is wanted, it is only necessary to release the ring, F, the plug, E, falls into the acid, the zinc, marble, &c., becomes covered, and the flow of gas begins and can easily be arrested in the manner first described.

The second form of apparatus, used when only a small supply of gas is wanted, consists of a Wolff's bottle, A, Fig. 2,

Fig. 2.



to one tubulure of which is fitted a cork carrying a glass tube and piece of caoutchouc piping, B. This pipe, B, can be closed by a pinch-tap, C. To the other tubulure of the Wolff's bottle is fitted the adapter, D, in which is placed the zinc, marble, or other gas-generating material. To the upper end of the adapter is fitted a cork and tube, E, serving for the escape of gas which is washed at F, and then passes on for use. To use the apparatus, the Wolff's bottle is charged with acid up to the level indicated in the figure. Then, on blowing air by the mouth by means of the tube, B, the pinch-tap, C, being open, acid is forced into the adapter, D, and gas at once comes off. The pinch-tap, C, is now closed, and the compressed air in the Wolff's bottle still keeps the acid in the adapter. When it is desired to stop the flow of gas, the pinch-tap, C, is opened, the compressed air escapes, and the acid in the adapter falls, leaving the gas-generating materials dry. Should the blowing of air by the mouth be deemed objectionable, an air-ball may be attached to the pipe, B. A safety-tube, C, is used, in order to prevent the liquid from the wash-bottle being drawn over on stopping the supply of gas.

Professor Schafarik, from Prague, read a "*Note on the Constitution of some Natural Silicates*," namely, those in which chlorine and fluorine enter as essential constituents. They are few in number, but some of them important—as mica, turmaline, topaz; others interesting for their rarity, as cudialyte, pyrosmalite, tencophane; or for their mode of occurrence—as sodalite. According to modern chemical views these minerals were, Dr. Schafarik said, considered as silico-fluorhydrines and silico-chlorhydrines—namely, as silicic hydracids, in which a part of hydrogen is replaced by metals, another part by a polyvalent metal only partially saturated by chlorine or fluorine. The formulæ of these substances were discussed at length, and graphically constructed, showing the most simple and probable manner in which the single atoms might be arranged. The most interesting results are those found for topaz, chondrodite, and turmaline. The first is remarkable for the simplicity and beautiful symmetry of the new formulæ, when compared with the unwieldy old ones. The other two mineral species are remarkable for variability of composition, which perplexed older chemists. The author shows that both are formed by the repetition of pretty simple fundamental molecules, which are linked together in any number like chains. In the case of chondrodite, the chain is open, as in fatty organic bodies; in turmaline, it is closed, as in aromatic compounds. Only in carbon compounds the carbon atoms themselves are linked together; in silicates the fundamental molecules are linked together by atoms of oxygen.—Experiments for testing these theoretical results are in progress.

Professor Lawrence Smith, of America, congratulated Dr. Schafarik on having taken the true direction in the study of silicates. Hitherto they had been labouring under great difficulty in the study of these substances, from the fact that they had had to proceed on very incorrect data. Their analyses of natural silicates were very imperfect. It would be necessary to introduce into the study of silicates the same system as was employed in the study of organic chemistry. Silicon would be found to resemble, he believed, in the mineral kingdom in a great many of its properties, carbon in its relations in the organic kingdom. If the study were pursued in the direction which had been indicated, he believed a great deal of light would be thrown on silicates.

Dr. Crum Brown dwelt upon the importance of distinguishing between mineral structural formulæ and organic formulæ, and said that Dr. Schafarik had advanced in the right direction in the grouping and classification of these minerals which he had adopted.

The President (Professor Russell) said the section was much indebted to Dr. Schafarik for the paper he had brought before the Section, and for pointing out the relationship between organic and inorganic chemistry, and applying to the latter the modes of reasoning and thought which had been developed in the former. In the organic branch they had fortunately got compounds which they could with comparative ease experiment with. He hoped that before long they would get a great deal more power over the silicon compounds than they had. There was some reason for believing that they might be able to build up minerals and decompose them with much greater facility at all events than they could at present.

Mr. A. H. Allen, F.C.S., followed with a paper "*On the Detection of the Adulteration of Tea.*" He said that, as public analyst for the borough of Sheffield, many samples of tea had been brought under his notice, chiefly by dealers themselves, in order to guard against selling tea, which, if they had been analysed by him officially, might have been condemned as adulterated. The analyses of tea up to the present time were by no means numerous; and some were so old that they might well be viewed with suspicion. The three principal constituents of tea were tannin, gum, and "woody fibre," with small quantities of some albumenoid body, theine (the active principle), colouring matters, chlorophyll, essential oils, &c. The proportions of these found by different analysts varied very much, the difference evidently depending upon the methods of determination employed. His object had been more to work out a technical method of testing teas for adulteration than to establish the actual composition of genuine tea. The estimations that had been made of tannin seemed to present the greatest variations, and in many cases they were manifestly wrong. A modification of Dr. Hassall's process, in which a volumetric solution of gelatin was used, had given him very concordant and reliable results, and had made the determination of tannin in tea an operation of a rapid and tolerably simple character. The use of a standard solution of gelatin for the determination of the strength of tannin

matters was nothing new; but he believed he had been the first to employ the process in the examination of tea. Mr. Allen then described the details of the method he employed in the estimation of tannin, stating that he had found by the process in genuine black tea of rather more than average quality 12·5 per cent of tannin, which presented a close agreement with those in the old analyses of Mulder, which he regarded as the most accurate and complete analyses of tea extant. The estimation of tannin was of the first importance; for if it reached the normal amount all question of adulteration by exhausted leaves was at an end, and foreign leaves were very unlikely to be present. The only fallacy in such a conclusion would be caused by an admixture of catechu, or sloe leaves. The next point of importance was the percentage of "woody fibre," as it was called by some analysts, and here, again, he was disposed to think that Mulder's analysis was the only accurate one. The percentage of gum, insoluble matter, and tannin in any sample of tea, considered carefully, would enable the analyst to form a very accurate opinion as to the presence or absence of exhausted leaves, &c. Analysed by the above described methods a sample of very superior black Congou tea gave the following results, which he had placed in juxtaposition with the numbers obtained after some of the same sample had been infused in the usual manner in the teapot (the exhaustion was not carried to excess, no second quantity of tea being used), and the leaves re-dried:—

	Original Tea.	Exhausted Tea.
Moisture	9·2	11·1
Insoluble matter	58·7	87·5
Gum	10·5	3·8
Tannin (by gelatin)	15·2	3·3

From this it would be seen that infusion in the teapot resulted in the increase of the insoluble matter by nearly 30 per cent, while the gum and tannin were much reduced in amount. Generally the exhausted leaves were re-dried and made up with gum, which gave them a peculiar glossy appearance, and was detected by excess on analysis. From a table which he had prepared of thirteen different analyses, he gave several instances of adulteration. In one case he was attracted by a table in a window, "Try our fine rough, flavoured, thick, sappy, Moning Congou at 2s. a lb." The specimen, when examined, was found to contain catechu, starch, magnesia, metallic iron, graphite, sand, &c. He had also found sloe leaves presenting a close resemblance to green tea in every respect. An inspection of the specimens analysed showed that genuine green teas were richer in tannin than black teas in about the proportion of two to three. This was no doubt due to the partial oxidation and destruction of the tannin during the process of fermentation to which black tea is subjected in the process of manufacture. Whether the acknowledged superior strength of green tea was due to the larger percentage of tannin present in it, he was not prepared to say. The determination of theine he had made did not account for the difference, and most analysts had found more theine in black than in green tea. The infusion of green tea was not nearly so strong in colour as that of black tea, though it was half as strong again in tannin, so that the depth of colour could not be regarded as a proof of strength, though generally so considered. If a solution of carbonate of sodium be added to a weak infusion of tea (strained away from the leaves) a considerable darkening was observed, though certainly the infusion could become no stronger. Thoroughly extracted tea leaves yield a brown liquid when treated with carbonate of sodium solution. These facts quite explained why careful housewives had a fancy for putting soda in the teapot, the infusion becoming sensibly darker by the addition, to say nothing of the extra colouring matter from the leaves. Apart from its softening effect on the water (the advantage of which he thought was doubtful), there could be no good reason for its addition. In the methods he had used for detecting facing and colouring there was not much that was new. On treating the tea with warm water the colours and facings came off, and on straining off the leaves and leaving the liquid at rest, they gradually settled to the bottom. If prussian blue or indigo were present the sediment generally had a bluish or greenish colour, and the tests for these pigments must be tried accordingly. Magnesia was often present both in the free state and as insoluble silicate. This latter facing he had found on several occasions lately on green teas of peculiarly smooth appearance and slippery feel. It was detected by heating the sediment with hot hydrochloric acid, and then with solution of caustic soda. The residue was ignited and fused with alkaline carbonate, the first product dissolved in acid, evaporated to dryness, re-dissolved in weak acid, the solution treated with ammonia and oxalate of ammonia, the precipitate filtered off, and the clear liquid tested in magnesium, in the usual way, by phosphate of sodium, when an abundant precipitate was obtained, proving the presence of magnesium as silicate.

The PRESIDENT observed that the Adulteration Act would no doubt have the effect of increasing the number of chemists in England, and such questions as that of the adulteration of tea would day by day become more important. He wished that a great many of the analysts appointed under the Act would follow Mr. Allen's very good example, and bring to the Association the results of their experiments. Mr. Allen had worked out the case of tea very thoroughly, and at the same time he had shown some of the pitfalls into which chemists were pretty sure to tumble sooner or later. There was a great deal to be done in these testings for adulteration, and to make the Act in any way useful the testings must be carried out in a most thorough and accurate way. He only wished all public analysts were as careful as Mr. Allen.

Mr. CAIL asked Mr. Allen whether he had made any analysis of the ash of the tea plant?

Mr. ALLEN said he had not; but that the ash should not exceed more than 5 per cent. Many of the things used for adulterating tea had more.

Mr. CAIL said he had made analyses, and found a good deal of manganese in the tea. He desired to know whether that was used for colouring, or whether it was got out of the soil by the growth of the plant. It might be used as a colouring in preference to prussian blue.

Mr. ALLEN said that manganese was understood to be one of the constituents of the ash of the tea; and added that he thought foreign leaves might be more easily detected by skeletonising the leaves than by simply putting them under the microscope.

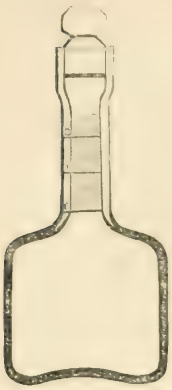
"*Specific Gravity Bottle for Liquids Spontaneously Inflammable in contact with Air*," by ALFRED TRIBE.

The bottle usually employed for sp. gr. determinations of liquids consists, essentially, of a light flask provided with a perforated stopper. By means of this arrangement sufficiently accurate results can be readily obtained when the liquid is not very volatile or violently acted upon by the air.

To meet the requirements of volatile liquids, Regnault employed a flask having a solid in place of a perforated stopper, and a neck somewhat longer and narrower than the old form. The liquid is poured up to a mark made on the neck, and the water value being known, the specific gravity is found. It is obvious that by this method loss by evaporation or expansion during weighing is prevented. For liquids, however, which are violently decomposed by the air, especially when with formation of thick clouds, *e.g.*, the zinc compounds of the lower members of the alcohol radicals, this plan, from the practical impossibility of adjusting with accuracy to the given work and the required temperature, is not so satisfactory as might be desired.

To meet liquids of this class I have devised the following improvement upon Regnault's bottle:—The neck is of as even bore as possible, and divided into as many equal

parts as can be conveniently read. The bottle (made by Cetti) actually employed, which answered perfectly, has a capacity of 2·6 c.c., the neck being about 3 m.m. internal diameter and 13 long, divided into ½ m.m. Just beyond the graduations the neck is widened somewhat for the stopper and for pouring in the liquid.



When once the water values have been determined for each division on the neck, it will be seen that it is only necessary to fill the bottle so that the surface of the liquid shall fall within the range of the graduations. Another advantage is that the contents can be raised or lowered to the normal temperature, and the volume read off, without addition or subtraction of liquid.

The ½ m.m. divisions of water weighed 5 milligrms. As it is easy to read to a half of one of these divisions, and, with care, to a quarter, the error need not be more than the weight of liquid equal to one or two milligrms. of water. A pipette with a capillary tube will be found convenient for introducing the liquid, and of course the operation of filling liquids of the character of zinc-ethyl should be done in absence, as far as possible, of free oxygen.

CORRESPONDENCE.

COPPER IN FEATHERS.

To the Editor of the Chemical News.

SIR,—In connection with a letter published in your last number, the following observations, made three or four years ago, may interest some of your readers:—

We kept at that time two Australian love-birds of the variety called *Melopsittacus undulatus*, small parrokeets, with grass-green plumage. The birds were often allowed to fly about the room, and I observed that they preferred brass fittings to any other perch, and that they used to sit and peck at the brass-work. On asking an Australian friend as to the habits of these birds, he told me that they abound chiefly in the districts where copper is found.

These facts, and the recollection of Mr. Church's discovery of copper in the red feathers of the turaco, led me to examine some of the feathers which these birds had let fall in flying about.

I collected seven or eight of the feathers, burnt them, and extracted the residual ash with nitric acid. On adding solution of potassium ferrocyanide to the filtrate, a distinct precipitate of the colour of copper ferrocyanide formed.

The cage in which the birds lived was of iron, not brass, wire; and as we had already had them more than a year, and they were in the habit of frequently washing themselves, it seems certain that the copper found in the ash existed naturally in the feathers.

Probably a green pigment, analogous to Mr. Church's turacin, of which copper is a constituent element, may be extracted from these feathers. My attention having been recalled to the subject by your correspondent's letter, I propose to examine it further.—I am, &c.,

SYDNEY LUPTON.

Christ Church, Oxford,
October 18th, 1873.

MANUFACTURE OF GAS.

To the Editor of the Chemical News.

SIR,—I am manufacturing gas upon my patent system of carbonising, which is done by passing the hydrocarbons over incandescent coke, therefore making more pitch than tar. The gas and pitch come into contact with water as they leave the retort; the result is that a green and a yellow-green colour is washed out of the pitch (which I take to be anthracen), the colour varying according to the quality of coal carbonised, when, after long exposure to light, it becomes black (oxidised), which resembles the sediment of black ink. Would you or any subscriber say if it is worth collecting?—I am, &c.,

A. MALAM.

Dumfries, Oct. 21, 1873.

NEW VOLUMETRIC ASSAY OF IRON.

To the Editor of the Chemical News.

SIR,—Many chemists will sympathise with Captain Ross in his protest against the shortcomings of discoverers (?) who publish as new facts processes so long since made public; but, with reference to the special grievance of the gallant captain, if he takes the trouble to refer to his letter to the CHEMICAL NEWS, vol. xvii., p. 23, he will see that, although he therein suggested the idea that ferric sulphocyanide might be used as an indicator in the well-known process of determining the combined acid in a metallic salt (such as a per-salt of iron) by means of a standard alkaline solution, he yet had not at that time carried out his idea to a practial result; and, moreover, that he took no account of the fact that all free acid must be absent. Now M. Charpentier, whom Captain Ross accuses of injustice, has at any rate these merits—that he made the process work (more or less accurately), and that he took cognisance of that latter very material circumstance.

In the letter referred to, Captain Ross solicited the opinion of chemists on his ideal process; in answer to his request, I pointed out—Firstly, that the process, as suggested by him, would give inaccurate results, from the necessary presence of free acid; secondly, that it is impossible to estimate accurately the amount of free acid in such in solution by the ordinary volumetric processes; and, thirdly, that the decolorisation of ferric sulphocyanide (and also of ferric ferrocyanide) is a less sharp terminal reaction than the change of colour in certain vegetable colouring matters. It may therefore be inferred (as is proved by actual experiment) that the Ross-Charpentier process is less convenient in practice than those in ordinary use.—I am, &c.,

C. R. A. WRIGHT, D.Sc.

Chemical Laboratory, St. Mary's Hospital,
Paddington, W., Oct. 22, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, September 22, 1873.

On Corallin.—M. Commaille.—Corallin is obtained at temperatures which may vary from 115° to 150°, at the latter temperature the yield is more considerable and the operation more rapid. The quantity of oxalic acid recommended by authors is far too high. Corallin does not give definite metallic salts, but merely coloured lakes. Yellow corallin is not an acid, for it does not expel carbonic acid from its combinations, and does not form

definite compounds with bases. The name of rosolic acid applied to it is quite incorrect. Red corallin does not contain nitrogen, and cannot therefore be an amide of the red variety.

Thermal Researches on the Condensation of Gases by Solid Bodies (Continued); Absorption of Hydrogen by Platinum Black.—M. Favre.—When hydrogen is brought in successive portions into contact with platinum-black up to saturation, the heat liberated is not constant for equal weights of gas absorbed, as in the case with palladium. Thus, in condensation of ordinary gaseous hydrogen by platinum, the first experiment gave 23,075 calories; the fourth, 13,528. Hydrogen condensed by palladium seems to be distributed in a uniform way throughout the metal, forming with it a true alloy; whereas hydrogen condensed by platinum-black is apparently distributed like carbonic acid or ammonia fixed by wood-charcoal, *i.e.*, forming layers less and less dense, from the surface of the metal inwards. It is a phenomenon of *capillary affinity*. It is likely that, as in the case of sulphurous acid and protoxide of nitrogen condensed by wood-charcoal, the heat liberated exceeds the latent heat of liquefaction of the gas. The author next considers what occurs in the electrolysis of sulphuric acid, *e.g.*, with a couple of zinc and palladium (Expt. I.), and one of zinc and palladium (Expt. II.). In the former case the gas is fixed in the active state by the palladium at the moment of leaving, the liquid and the 9000 calories or so liberated in fixation are the thermic expression of the condensation; in which the gas has passed to the *solid state* without ceasing on that account to be active. In the case of zinc and platinum, however (Expt. II.), the active hydrogen, issuing in the state of a true explosive substance, undergoes an allotropic modification, and is transformed into ordinary and liquid hydrogen. In this transformation, notwithstanding absorption of heat through passage of the hydrogen, thus formed from the liquid to the gaseous state, the calorimeter shows about 4600 calories. Recurring to the condensation of ordinary gaseous hydrogen by platinum, it appears that the hydrogen active and liquid (*i.e.*, existing in the liquid compound from which it is separated), which liberates about 4600 calories in passing to the ordinary gaseous state, and about 20,700 calories in being fixed by platinum-black after this transformation, would liberate about 25,300 calories if it did not undergo a transformation before its condensation by platinum, at the surface of which it ceased to be in the active state. Another conclusion is that the active and liquid hydrogen, which liberates only about 9000 calories, in being fixed directly by the palladium (Expt. I.) must necessarily, remaining active, constitute with this metal a true explosive alloy, susceptible of liberating about 14,000 calories by decomposition into palladium and ordinary hydrogen, supposed in the solid state. From these and other thermal phenomena studied it seems well established that the hydrogen entering into the formation of acids is in the active state, and M. Favre thinks the same may be said of the hydrogen in water. The thermal phenomenon of the formation of water, and that of its decomposition are not, he remarks, so simple as might at first be supposed. Starting with the constituents of water, taken in the ordinary state, the quantity of heat shown by the calorimeter is the algebraic sum of the numbers furnished by the following phenomena:—(1) Passage of hydrogen and of oxygen, ordinary and gaseous, to the active and also gaseous state; (2) combination of these elements thus modified; (3) passage of water vapour to the liquid state.

Some Peculiarities Relative to the Winged Form of Phylloxera, as Regards Propagation of the Insect.—M. Cornu.—The author arrives at the conclusion that the winged individuals of *Phylloxera vastatrix* are much more numerous than has hitherto been thought: that they use their long and fragile wings (as the *Phylloxera quercus* also does), and with the aid of wind may be carried a considerable distance. The observation has an important bearing on the choice of remedies.

The Most Suitable Time to Apply Submersion to Vines Tainted by Phylloxera.—M. Faucon.—The author states objections to submersion in either spring or summer.

Integration of Equation with Partial Derivatives for Isostatic Cylinders Produced within a Mass Subjected to Strong Pressures.—M. Boussinesq.

Movement of an Elastic Wire, one Extremity of which is Animated by a Vibratory Movement.—Second note by M. Mercadier.—An eighth law is added for the normal vibratory state, viz., that for different wires of the same section the normal nodal distances are proportional to the fourth roots of the quotients of the coefficients of elasticity divided by the density. Coming to the *abnormal* vibratory state, the author describes the phenomena obtained on shortening the wire, millimetre by millimetre, beginning with the normal state. The vibrations become curvilinear, and this amplitude increases, while that of the diapason diminishes, and may even become *nil*. On further shortening the same phenomena are reproduced, but in reverse order; till the normal state recurs, the vibrations of the wire becoming plane. The author constructed two curves, having for abscissæ the lengths of wire, and for ordinates of the one the amplitudes of the free extremity of the wire; for those of the other the amplitudes of the diapason. The following laws are deduced:—(9) The lengths of wire for which the amplitude of the free end is minimum and equal to that of the diapason are, commencing with the shortest, in arithmetical progression, the ratio of which is precisely the normal nodal distance of the wire. (10) The lengths of wire corresponding to the points of complete extinction of the diapason are also, commencing with the shortest, in this arithmetical progression. (11) Each of the points corresponding to mininum amplitude of the wire is very nearly at equal distance from the two points of extinction of the diapason, between which it is comprised. The foregoing research has a practical bearing on the question, viz., what length to give a style fixed to the end of a vibrating body (tuning-fork, *e.g.*), so as to have the greatest amplitude possible without altering the vibratory period of the diapason. The abnormal vibratory state must evidently be avoided.

Proportion of Carbonic Acid in Atmospheric Air; Variation of this Proportion with the Altitude.—M. Truchot.—The observations were made almost daily during July and August at Clermont Ferrand. The method consisted in passing the air into baryta water previously titrated, then allowing deposition of the carbonate formed, then titrating anew the limpid supernatant liquor, a known quantity of which was separated with a pipette. The numbers obtained show—(1) That the proportion of CO_2 is a little greater during the night than during the day (as was previously observed by De Saussure and Boussingault). (2) That the proportion is not sensibly higher in the town than in the country. (3) That in the neighbourhood of plants with green leaves in full vegetation the proportion of CO_2 varies considerably according as these green parts are illuminated by the sun, or are in shade, or quite in darkness; this agrees with a well-known fact in vegetable physiology. (4) That, on a general average, the proportion is 4·09 vols. per 10,000 vols. of air, which closely agrees with the numbers obtained by De Saussure (4·15); Thenard and Boussingault (4); and Verver (4·2); but is much higher than those of German observers, Schulze (2·9), and Henneberg (3·2) at Rostock and Weende. To ascertain the influence of height, determinations were made simultaneously at Clermont Ferrand, 395 metres above the sea; at the top of Puy du Dôme, 1446 metres; and at the top of Lancy, 1884 metres. The respective numbers were 3·13 vols. (per 10,000 of air), 2·03, and 1·72; showing a marked decrease with the height. This is not surprising when one

considers that, on the one hand, it is at the surface that CO_2 is produced; and, on the other, that it is considerably heavier than air.

Observation, on the Night of Sept. 20, 1873, of a Bolide which left behind an Incandescent Train.—M. Chapelas.—The train, observed through a telescope, presented a remarkable undulation. It continued ten minutes after the complete disappearance of the meteor, having the same direction. Then, becoming more compact and brilliant, it suddenly took the direction of the wind, N.W. to S.E. (being originally N.N.W. to S.S.E.). A very thick mist covered Paris immediately afterwards.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxii., No. 5, October 2, 1873.

Transparent Paper.—The paper is soaked in the following composition:—Linseed oil, boiled and bleached, 20 kilos.; lead turnings, 1 kilo.; oxide of zinc, 5 kilos; Venice turpentine, ½ kilo. The whole is mixed and boiled for eight hours; after cooling it is stirred, and the following ingredients added:—White copal, 5 kilos.; and sandarac, ½ kilo.

Poisonous Nature of Cobalt.—According to Siegen the nitrate and chloride of cobalt rank among poisons. 1 centigrm. of either of these proved fatal to a frog in half-an-hour; 3 decigrms. killed a strong rabbit in three hours. The poison acts directly upon the muscles of the heart.

Indelible Ink.—Elsner takes equal parts of copperas and vermillion, powders, sifts, and grinds with linseed oil; the whole is finally pressed through linen. The thick paste can be applied for writing and for printing on wool or calico. It resists bleaching.

Revue Scientifique de la France et de l'Etranger, September 12, 1873.

Meeting of the French Association for the Advancement of Science at Lyon.—*Chemical Section*, August 25.—Ch. Blondeau—proceeding on the theoretic idea that sugar introduced into the animal organism can be transformed into alcohol and carbonic acid by the action of the blood globules playing the part of a ferment—brought blood and glucose into contact and obtained alcohol, the nature of which he verified by taste; smell, and by its reaction with the permanganate of potassa. Hence he infers that there occur in the system phenomena of fermentation calculated to split up sugar into alcohol and carbonic acid. The fermentation of sugar under the influence of blood has been confirmed by M. Béchamp.

M. Balard remarked that the characteristics adduced by M. Blondeau were insufficient to prove the presence of alcohol.

M. Wurtz pointed out that the procedure of Gay-Lussac (repeated distillation over carbonate of potassa) rendered it practicable to isolate very small quantities of alcohol, and that the presence of this body could be demonstrated by transforming it into iodide of ethyl.

M. Friedel gave a summary of the researches which he had carried on in concert with M. Silva on pinacon, $C_6H_{14}O_2$, obtained by the hydrogenation of aceton. He explained the most advantageous method of preparing pinacon, and described the action of perchloride of phosphorus upon this compound. Perchloride of phosphorus acts upon pinacon, a tertiary glycol, not by forming the normal chloride $C_6H_{12}Cl_2$, but a chloride, $C_6H_{11}Cl$, representing the normal chloride, less a molecule of hydrochloric acid. At the same time the perchloride exerts a chlorinising action upon $C_6H_{11}Cl$, producing in the same reaction a crystalline body, $C_6H_{10}Cl_2$. These two chlorides, $C_6H_{11}Cl$ and $C_6H_{10}Cl_2$, are not saturated, as they can fix 2 atoms of bromine yielding respectively $C_6H_{11}ClBr_2$ and $C_6H_{10}Cl_2Br_2$. To obtain the normal chloride, $C_6H_{12}Cl_2$, it is necessary to have recourse to the less violent action of oxychloride of phosphorus upon pinacon, or to that of the perchloride of phosphorus upon pinacolin, $C_6H_{12}O$. The chloride, $C_6H_{12}Cl_2$, crystallises and is identical with the bichlorated di-isopropyl described by M. Silva.

MM. Friedel and Silva have also studied the action of nascent hydrogen, and that of oxidising agents upon pinacolin. By hydrogenation two compounds are obtained; a crystallised body resulting from the fixation of 2 atoms of hydrogen upon 2 molecules of pinacolin, and containing $C_{12}H_{26}O_2$, and pinacolic alcohol, $C_6H_{14}O$. Of this alcohol the authors have prepared the iodide, the acetate, and the benzoate. On oxidation it reproduces the pinacolin. The oxidation of pinacoline gives rise to pivalic acid, $C_5H_{10}O_2$, isomeric with valerianic acid, crystalline, and fusible at 30°. This acid appears identical with the trimethyl-acetic acid of Boutlerow.

M. D. Tomasi has been occupied with the action of the chloride of chloracetyl upon various primary monamines of the aromatic series. He has obtained chloracetanilide, $C_6H_5NHC_2H_2ClO$, chloracetyl-toluidin, and chloracetyl-naphthylamin. He described also chloracetyl-urea.

Ch. Risler gave a summary of the most recent analytical applications of the hydrosulphite of soda.

MM. Schützenberger and Risler have applied the reducing power of this salt to determine oxygen dissolved in water and in blood. M. Risler described the apparatus employed in these determinations.

MM. Schützenberger and Quinquand have applied the same reaction to study the respiration of submerged aquatic vegetation, and to ascertain the action of beer-yeast upon dissolved oxygen.

SESSION OF AUGUST 27th.

M. A. Henninger has studied the reducing action of formic acid upon alcohols of different atomicities.

M. Wurtz, having obtained the normal density of the perchloride of phosphorus by allowing it to diffuse in one of its products of dissociation, the protochloride of phosphorus, attempted to find the normal density of the hydrochlorate of ammonia by an analogous procedure. He caused this salt to diffuse in hydrochloric gas, but sal-ammoniac volatilises at a very elevated temperature, at which it becomes entirely dissociated in spite of the presence of hydrochloric gas. The density yielded by experiment in these conditions corresponds to four volumes of vapour, that is, to a complete dissociation of the salt into hydrochloric acid and into ammonia. M. Wurtz called attention to the generality of the phenomena known as dissociation.

M. G. Loremoine described the transformation of white phosphorus into the red state, and the curves of dissociation of hydriodic acid.

M. Ribau explained his interesting researches on the terebic carbides, and the isomerism of their hydrochlorates.

M. Gourdon, of Lyon, described some novel facts which he had observed in the action of acids upon zinc covered with certain metals. Zinc plunged into dilute solutions of sulphuric, hydrochloric, and acetic acids is attacked only at the points where other metals are present. The metals which produce this phenomenon with most intensity are cobalt, platinum, nickel, and iron. Ammoniacal chloride of cobalt renders it possible to perforate zinc with water containing only 1-10,000th part of sulphuric acid. M. Gourdon applies these results to various procedures for engraving. By writing directly upon zinc with different metallic inks, making use of the most active, containing salts of cobalt for the blackest parts, and passing it then into acidulated water, an engraved plate is obtained. To reproduce leaves or plants they are soaked in solutions of metallic salts, and applied to the zinc, which is then treated with weak acid. The author has discovered a new kind of heliographic engraving by transferring the silver from an ordinary photographic proof upon the zinc, which can be attacked by the acids in the parts where the silver has been deposited.

M. Vidal described his process of polychromic photography.

M. Vignon has prepared mannitan by mixing mannit with half its weight of concentrated sulphuric acid, and keeping the mixture at 125 for two hours. Mannitan turns the plane of polarisation to the right, and does not yields mannit even on boiling with baryta water for an hour. If mannit is heated to 280° with a little water a body is obtained which appears to be mannitan, but which turns the plane of polarisation to the left, and yields mannit on boiling with water.

M. Vignon has likewise examined the action of sodium amalgam upon ammoniacal salts, and determined the conditions under which the greatest quantity of the ammoniuret of mercury is produced. The sodium amalgams are less efficacious the more sodium they contain. With nitrate of ammonium sodium amalgam does not yield an ammonium amalgam. There is a brisk effervescence due to the escape of nitrogen. In fact if nitrate of potassa is treated with sodium amalgam, nitrogen is evolved, and nitrite of potassium formed. As sodium amalgam does not act upon the compound ammonias, M. Vignon proposes the use of this amalgam to detect the presence of ordinary ammoniacal salts in the salts of the compound ammonias.

M. Grüner has been engaged with measuring the quantity of heat needful to effect the fusion of cast-iron slags, dross, and steel, in order to compare the heat produced in blast-furnaces with the heat utilised. He finds that cast-iron melts at from 1579° to 1462°. Bessemer steel melts at 1600°.

Session of August 28th.

M. Masson, of Lyon, exhibited various specimens of veterinary medicines.

M. Perret exhibited hydrochlorate of trimethylamin obtained from herring-brine, anthracen, valerianate of quinine obtained by the double decomposition of sulphate of quinine and valerianate of baryta, slightly basic.

M. Jacquemin's paper "On the Analytic and Toxicological Detection of Phenic Acid" was read. The reaction upon which the author's method depends is the blue colouration produced by hypochlorite of soda in a mixture of phenol and anilin. It was remarked by several members that anilin alone gives a blue reaction with alkaline hypochlorites.

M. Macé sent in a memoir on the existence of germ ferments in living organisms. He maintains that germ ferments may exist for a time in the organism in a passive state.

No. 13.

Photometry of Absorption Spectra, and its Application to Quantitative Chemical Analysis.—Ch. Vierordt.—This paper, translated from the German, is not suited for abstraction.

No. 14.

This number contain no chemical matter.

Reimann's Färber Zeitung, No. 33, 1873.

This number contains receipts for green, crimson, and yellow on shoddy, and ponceau on cloth, and for blue and brown on silk.

In reviewing the Vienna Exhibtion, the beautiful sugar-of-lead and yellow prussiate in the Austrian department are spoken of as far surpassing any similar articles from the German Empire. Joseph Nowak, of Prague, exhibits starch in all preparations, flavin, and lake colours, especially a cochineal ponceau, and a fustic lake ready for direct application in calico- and woollen-printing. It is remarkable that Austria has not a single manufacture of anilin and anilin colours; this is ascribed, in part, to the fact that lignite is almost exclusively used in the Austrian gas-works, the tar being consequently very poor in benzol. The Austrian printed calicos, especially those of Franz Leitenberger, of Cosmanos, deserve commendation, as also the turkey reds. There is a fine display of gauze printed with woollen dust; the designs are printed upon the goods in starch-paste mixed with gum, and the dust of coloured wool applied, which adheres only to the moist parts; rich and novel effects are produced by this style, which is much admired for ball costumes.

The editor gives also receipts for black and brown on plush; for a salmon on wool and woollen yarns; for a light scarlet on the same materials, remarkable for the total absence of oxalic acid, the wares being, to 100 lbs. of wool—3 lbs. of tin crystals, 3 lbs. of tin-composition (perchloride), 3 lbs. of tartar, and ¾ lb. of cochineal. Further is a medium blue-green on woollen cloth, and three receipts for printing greens on calico.

No. 34, 1873.

An extract of sumac is now in great request. It is prepared by exhausting the ware with water, and careful concentration in a steam-bath, generally with the aid of the vacuum-pan. It is sold as a thick syrup, of a pure astringent taste, without the slightest acidity. This permanence is ascribed to the high concentration which appears to hinder the transformation into gallic acid.

In the French department we find a splendid assortment of anilin colours. Noteworthy is a corallin, said to be able to bear clearing *(avigage)* at a boiling temperature. The dye extracts of Coëz, and the natural alizarin and purpurin, orcin and orcein, of Meissonier also deserve mention.

The instructions for dyeing and finishing plush are continued. There is a receipt for Bordeaux—*i.e.*, cherry-brown on wool, and a porcelain-white on the same material.

The announcement appears of an international exhibition of textile manufactures, to take place in Berlin.

For a black on cotton-wool, the goods are to be boiled for three hours in logwood liquor (30 lbs. to 100 lbs. of cotton); worked in a cold bath of 15 lbs. of chromate of potash and 10 lbs. of blue vitriol for an hour; put back into the old extract bath, cooled down to 60° R. (= 167° F.), in which 10 lbs. of soda-ash have been dissolved; worked for two hours, and saddened with 10 lbs. of copperas. A Dr. Kielmeyer recommends the use of acetate of iron, made by the direct action of crude pyroligneous acid upon scrap-iron (general in this country), in preference to the kind made by double decomposition of copperas and sugar-of-lead. He points out the (well-known) value of the tarry impurities in preventing peroxidation of the iron. He explains the addition of arsenious acid to black-liquor as calculated to exert a similar action. He concludes with the strange statement that acetate of iron at 20° Baumé is chiefly used in *woollen* dye-works for dyeing a black, the *tarry matters co-operating as a black-dyeing ingredient!*

Annalen der Chemie und Pharmacie, band clxviii., heft 2 and 3 (Neue Reihe, band xcii., heft 2 and 3), August 30, 1873.

On Ethyl- and Diethyl-Allylamin.—Albert Rinne.—The author finds that diethyl-allylamin is isomeric with the ethyl-piperidin of Cahours, its boiling-point being 25° lower.

Examination of the Isomeric Cresols, with reference to their Occurrence in Coal-Tar.—M. S. Southworth.—The author has examined meta-, ortho-, and para-cresol.

Sorbic Acid.—E. Kachel and R. Fittig.—(Second treatise).—An examination of sorbic tetrabromide, with its sodium, potassium, calcium, and zinc salts; the decomposition of the above salts by the action of heat; their behaviour with hydrogen; sorbic dibromide or dibrom-hydrosorbic acid and hydrosorbic acid.

Processes in the Interior of the Non-Luminous Flame of the Bunsen Burner.—R. Blochman.—A lengthy and exhaustive paper, illustrated with three plates, and occupying more than sixty closely-printed pages.

MISCELLANEOUS.

Public Analysts.—Mr. Wentworth L. Scott has lately been appointed Public Analyst, under the Adulteration of Food Act, for Derbyshire and Stafford, by the Justices for these counties respectively. Mr. Charles H. Piesse has been elected to the office of Public Analyst for the Strand district.

Metropolitan Gas.—Dr. Letheby, the chief gas-examiner appointed by the Board of Trade, has recently reported to the Corporation of London and the Metropolitan Board of Works of the quality of the gas supplied by certain of the Gas Companies during the last three months, and from this it appears that the average illuminating power of the common gas has been as follows:—Chartered Gas: at Beckton, 17·46 standard sperm candles; at Cannon Street, 16·58 candles; at Friendly Place, Mile End, 17·29 candles. Imperial Gas: at Carlyle Square, 17·51 candles; at Camden Street, 16·78 candles; at Graham Road, 16·51 candles. South Metropolitan Gas: at Hill Street, Peckham, 17·15 candles. The cannel gas of the Chartered Company has averaged 21·54 candles at Millbank, and 21·16 candles at Ladbroke Grove. These results show that the illuminating power of the gas has been fully equal to the requirements of the Acts of Parliament. With respect to impurity, Dr. Letheby reports that the gas at all the testing-places has contained less ammonia than is prescribed by the referees, viz., 2·5 grains per 100 cubic feet of gas. The Chartered gas has been constantly free from sulphuretted hydrogen, but that of the Imperial Company and South Metropolitan Company has at times been charged with sulphuretted hydrogen, arising from accidental causes, created by the new regulations concerning the proportion of sulphur permitted to be present in the gas. The average amounts of this impurity has been as follows:—Chartered Gas: at Beckton, 12·44 grains per 100 cubic feet; at Cannon Street, in the City, 12·02 grains; at Friendly Place, Mile End, 13·77 grains; at Millbank, Westminster, 19·27 grains; at Ladbroke Grove, Notting Hill, 17·78 grains. The Imperial Gas: at Carlyle Square, Chelsea, 18·09 grains; at Camden Street, Camden Town, 12·27 grains; at Graham Road, Dalston, 17·60 grains. And the South Metropolitan Gas, 22·87 grains. Dr. Letheby remarks that the proportion of sulphur in the South Metropolitan gas compared with that in the Chartered gas indicates a want of skill in the conduct of the operations, which no doubt will be improved.

NOTES AND QUERIES.

Dyeing Black Kid.—Could any of your readers inform me how kid is dyed black, or where I might be able to get the information?—Subscriber.

Detection of Petroleum Spirit in Coal Naphtha.—Will any of our readers kindly inform me of a reliable method for the detection of petroleum spirit when present in coal naphtha? It being often used as an adulterant also, how can I distinguish between crude Scotch and English naphthas?—E. J. D.

Separation of Iron from Nickel and Cobalt.—Fresenius, in his "Quantitative Analysis," gives, for the separation of iron from nickel and cobalt and strong bases, a method which depends upon adding a solution of ammonia carbonate to the solution until the solution has lost its transparency. Will you kindly inform me, through the medium of your valuable paper, whether the carbonate used in this method is a solution of the ordinary solid carbonate, or a solution of the solid made neutral by ammonia?—A Beginner.

Notes on the Utilisation of Sewage.—(From the "Report of the Main Drainage Committee for 1864," vol. 487).

1313. (To Sir Charles Fox.) That would be 132,727,272·7 tons per annum would it not?—Yes.

(Mr. Smith.) The sewage proper will take 4,702 horse-power to lift it 180 feet, that is, allowing for friction; and for dealing with the gross sewage it will take 19,096 horse-power.

(Sir Charles Fox.) That is, Watt's horse-power of 33,000 lbs. lifted.

1321. (Sir Charles Fox.) We have taken 180 feet as the average height to which the whole sewage of London will have to be lifted; that is, of course, too much for some cases, and too little for others, but on an average we think it will meet the whole case.

1407. (To Mr. Smith). You propose to construct, as filters, from 500 to 1000 acres of osier beds through which you will pass the sewage after it has left the other lands, in order fully to deprive it of all deleterious and injurious matters; are you uncertain as to the size of these osier beds?—The London Waterworks allow 2 square yards for a gallon of water per minute, and I think we have more than 10 square yards per minute.

1409. (Sir Charles Fox). The water that is used for the purposes of irrigation and fertilisation must in a great measure find its way back again into the river; but our object is, to rid it of all its fertilising properties, and after it has been applied to the land to make use of it again in the growth of osiers; that is a very profitable operation, and it will take the last fertilising properties out of the water.

1410. (To Mr. Smith). Has the osier any peculiar property of deodorising the water?—We always find osiers precipitating to a great depth in search of water, and, if you have a sewer or a drain, it is almost certain to be filled with roots of willows or osiers.

1411. (To the same). Then it is not peculiarly valuable as a deodorant?—Its peculiar value is that it grows in water; the alder would be equally as good as the osier.

(Sir Charles Fox). The osier is of unusually rapid growth, and consequently requires more fertilisation.

1416. (To Mr. Smith). In frost the sewage does not sink into the land, does it?—I think it will. The temperature of the sewage, according to Mr. Mechi, is quite high enough to thaw a hard frost sufficiently to soften it.

(Sir Charles Fox. I thought that the sewage would find its way back to the Thames, but Mr. Mechi thinks not, and Mr. Smith agrees with him.

1442. (To Sir Charles Fox). Then would not the fertilising matter of the sewage be in great dilution?—In ordinary storm-water, the fertilising quality of the water is rather greater than under ordinary circumstances, from the fact of the water washing out the deposit from the bottom of the sewers. It so happens that the first portion of the storm-water washes out the greater portion of accumulation in the sewers, and that would pass away on to the lands, and it would only be the latter portions of the storm-water, which are very free from injurious matter, which would go into the River Thames, and that only during some of the summer storms.

1529. (To Mr. Smith). Could you supply the farmers by measure through the pipes?—Yes, certainly, or by meter.

1530. (To the same). Do you propose to do it through a gauge?—Yes.

1531. (To Sir Charles Fox). Would not the gauge stop the flow of the sediment to a considerable extent?—No, there are plenty of water-meters that would let any sewage pass through without the slightest difficulty; in fact, perhaps one of the best is simply a screw beautifully hung, which the fluid turns round in passing through, and regulates the quantity with considerable nicety by the number of its revolutions, which are registered.

1816. (Mr. Ellis). At page 36 of the First Report of the Select Committee on the Sewage of Towns, at question 776, Professor Way is asked "You have made experiments on the power of soils to absorb the manure contained in sewage?—Yes. Will you inform the Committee what were the results obtained by you?—The results generally were these:—That in soils there resides a power, which, previously to my examinations, I believe was not recognised, to separate from liquids containing manure—containing ammonia, for instance, and potash, and phosphoric acid, and magnesia, that is to say, all the important elements of manure, these elements; to separate them from water, not by mere filtration, because these things would pass through a filter, but by the peculiar chemical attraction possessed by the ingredients of a fertile soil for these liquids, so that if we were passing a liquid containing manurial matters through a given quantity of soil, the water would pass through, and these matters would be retained and fixed in the soil. I look upon this as a great arrangement and provision of Nature for the preservation of manuring principles from being washed out of the soil by rains."

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

An improved mode of reducing metals from their ores, and purifying and refining the same. Richard Werdermann, civil engineer, Princes Street, Surrey. February 10, 1873.—No. 474. My said invention relates to an improved mode of applying electric currents in order to reduce metals directly from the ores with or without the ordinary chemical action of carbonaceous matter, and in purifying and refining at the same time and by the same process the metal during its reduction from the ore.

An improved mode of and apparatus for purifying and refining metals and alloys. Richard Werdermann, civil engineer, Princes Street, Surrey. February 10, 1873.—No. 476. My said invention consists in an improved mode of applying electric currents to remove the noxious elements mixed or combined with the metal or alloy, and to permit such noxious elements when required to be collected and purified; it also consists in improved apparatus whereby the currents are effectually employed.

A new or improved composition or paint to be used for coating metal and other substances. Walter Chidiock Nangle, Bull Point, near Devonport, Devon. February 11, 1873.—No. 495. This composition or paint is composed of coal-tar, rosin, plaster of paris, dry red-lead, spanish brown, and benzolin. The rosin is first dissolved by heat, then mixed with the plaster of paris; to these are added some tar, red-lead, and spanish brown, and when well mixed the remainder of the tar and other ingredients are added, and the whole boiled. When cold, the benzolin is added. This paint is particularly recommended for pre-

serving iron, but may also be applied with advantage as a coating for other metals and substances.

Improvements in the manufacture of chlorine. Henry Deacon, alkali manufacturer, Appleton House, Widnes, Lancaster. February 11, 1873.—No. 505. This invention relates to improvements upon Deacon's chlorine process, and consists in mixing the active substance or substances employed with one or more substances of another class, which when used alone are inactive or inert, that is, do not possess the power of decomposing heated hydrochloric acid gas and air or oxygen in any material degree, but when mixed with the sulphate of copper, *cæteris paribus*, materially increase its activity in this respect. Sulphate of soda and sulphate of potash are types of this class of inactive but, so to say, accelerating substances.

Improvements in the manufacture of corks, and in the apparatus employed therein. Jules Salleron, cork manufacturer, 24, Rue Pavée, Paris. February 11, 1873.—No. 509. The invention consists—First. In testing the cork by submitting it to a pressure of 6 to 7 atmospheres in presence of pure or alcoholised water, in which cork of bad quality becomes spotted and black; the soft parts of the corks hollow out, and the cork itself assumes an oval form, and loses its form if the cork is of bad quality. Secondly. In forming the corks of pieces of thin cork of good quality grouped together so that the front of the bark shall form the circumference of the cork, and the hard veins in supporting each other form a cork of equal elasticity throughout its diameter and very strong; and in attaching these pieces together by means of a solution of dry india-rubber before being pressed together, partly in cementing a disc of cork for the head of the cork. Thirdly. In forming the corks of two pieces of cork back to back with a cement of india-rubber so as to leave the front outside. Fourthly. In covering the corks of an inferior quality with a sheet cut from cork of good quality parallel to the hard layers of the back.

An improved process to be employed in the manufacture of manures, and machinery or apparatus therefor. Samuel William Maquay, Charlemont Terrace, Dublin. February 12, 1873.—No. 512. This invention consists in manufacturing manures from coprolites or similar substances by the continuous application and employment of acid and other gases within closed vessels in connection with endless elevators and revolving stirrers.

Improvements in the manufacture of manure and apparatus therefor. Hugh Campbell, physician, 38, Queen Anne Street, Cavendish Square, Middlesex. February 12, 1873.—No. 513. To saturate absorbent and nitrogenous substances with solutions and liquids containing ammoniacal salts, ammonia, or its chemical elements, and afterwards to reduce the combinations so obtained to powder, so as to facilitate their rapid, cheap, and easy distribution over land.

Improvements in obtaining oxygen. Charles Weightman Harrison, High Holborn, Middlesex. February 12, 1873.—No. 528. This specification describes obtaining oxygen from atmospheric air by passing the air into suitable porous substances or by precipitating the oxygen of the air by magnetic or electro-magnetic action.

The manufacture of a new composition for the removal and prevention of incrustation in steam-boilers. Charles Burfitt, civil engineer, Surrey House, New Wimbledon, Surrey. February 13, 1873.—No. 538. The above composition not only effects the removal of old deposits, and prevents any fresh incrustation from forming, but effectually preserves the iron, and at the same time is free from any ingredients that are injurious to the cocks, valves, or other portions of the mdchinery. The composition is manufactured in three forms for the convenience of users. The *block* form can be applied to stationary boilers through the man-hole. The *liquid* form can be applied to stationary or locomotive boilers through feedwater cistern, or through safety-valve by shutting off the steam. The *paste* form contains ingredients almost identical with the liquid, and is in fact a highly condensed form of the liquid. It is manufactured for the especial purpose of saving space and expense in transit. On being liquidised in warm water it can be applied to boilers in same manner as the liquid form.

Improvements in the manufacture of sulphurated lead, in apparatus therefor, and in its application to various useful purposes. James Noad, engineer, of Bower Road, Hackney Wick, in the county of Middlesex. February 13, 1873.—No. 539. My invention relates to the manufacture of a compound of sulphur and lead, which possesses very peculiar properties, and is applicable to many useful purposes. I use two pots placed over separate fires, and connected by pipes with a mixing chamber. The latter is to be provided with an inlet pipe for air or steam, and an outlet pipe leading to a condenser. It also has a rake or rabble. I melt lead in one of the aforesaid pots, and sulphur in the other; when the lead is heated to about 710° F., and the sulphur to its melting-point, I open the communications, allow the liquids, in the proportion of 5 parts lead and 1 part sulphur, to flow into the mixing chamber. The lead has by this treatment been converted into a dark grey brittle powder. The said powder, after being ground, sifted, bolted, or floated, and dried, will be ready for use for various purposes.

TO CORRESPONDENTS.

R. Brown.—Nearly neutralise with carbonate of soda, and precipitate the gold in the metallic form with protosulphate of iron.

R. Riley.—(1). Write to Trübner and Co., foreign booksellers, Ludgate Hill, for the American journals; they are published weekly. (2). About the end of the present year.

BOOKS RECEIVED.

The Worthies of Cumberland. By Henry Lonsdale, M.D. G. Routledge and Sons.

An Easy Introduction to Chemistry. Edited by the Rev. Arthur Rigg, M.A. London, Oxford, and Cambridge: Rivingtons and Co.

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Practical Instruction in Mineralogy and Geology is given by Prof. TENNANT, F.G.S., at his residence, 149, Strand, W.C.

ROYAL POLYTECHNIC.—Notice.—THE ENCHANTED GLEN (written by Dr. Croft), notwithstanding its great popularity, cannot be given after November 8, in consequence of the engagement of Mr. Howard Paul. This week 300th representation; Mr. Hartwell. New Lectures by Professor Gardner:—1. "The Silber Light;" 2. "Sugar, from the Cane to the Teacup;" "Home Electricity," Mr. King. Other Novelties.—Open daily, 12 to 5 and 7 to 10. Admission, 1s.

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THE CHEMICAL NEWS.

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PUBLIC ANALYSTS.

A number of important chemical appointments have been created by recent legislation, and it is matter of notoriety that some of these appointments are filled by persons only very imperfectly qualified to discharge the duties devolving upon them. We allude to the public analysts, and invite our readers to inspect the official list of these appointments. It is indeed doubtful whether there exist in this country a sufficient number of duly qualified persons to fill all these offices; and we observe, accordingly, a very portentous development of pluralism—one gentleman and his assistant (or coadjutor) having been actually appointed public analyst for no fewer than *seventeen counties*. As we have said, there is a dearth of competent analysts, and to some extent pluralism is excusable. We can, however, hardly avoid thinking that the exigencies of the case do not warrant the entrusting of so many of these appointments to the same hands, and we hope that, on the expiration of the official year, these gentlemen will be relieved of a portion of the burden and responsibility which has been laid on their shoulders. Passing from the office holders to the work which they have accomplished, we have to note an unpleasantly large number of errors, and a growing distrust of the official analyst.

Liverpool and Glasgow have, each of them, had their butter-scandal, and even the milk-analysis of a public analyst has been called in question. In London there have been alum-convictions of the most doubtful character, and, at the present moment, there is a tea-controversy in Birmingham.

It was indeed inevitable that, on the first establishment of the office of public analyst, there should be a good deal of blundering on the part of the officer; and it is perhaps matter of congratulation that the early blunders have been so very patent and instructive. A fact which might otherwise have been ignored has been made very apparent, namely, that the ordinary laboratory course which a chemical student passes through in this country, is totally inadequate to prepare him for the discharge of the new duties, and that special instruction is imperatively demanded. It has curiously enough happened that the most notorious and picturesque failures, on the part of the public analyst, have been instances where the analyst had enjoyed the advantage of the ordinary analytical course, and where he probably presumed on the adequacy of such a training.

If we had been asked to say beforehand how it would be, we should have been disposed to point to the medical man, with a smattering of chemistry, who had taken office on the strength of the smattering, and should have looked for striking blunders from that quarter. And no doubt, too, there will be cases of wonderful failure of this description. The danger from this source is indeed so real as to need no special illustration; and it is well that the early working of the new regulations has proved an illustration of dangers which were by no means obvious.

THE POLLUTION OF RIVERS' BILL.

(Second Article.)

Before proceeding further with our examination of this Bill, and of the evidence laid before the Committee of the Lords, we cannot help quoting a portion of Sir W. Fergusson's address delivered at the meeting of the British Medical Association, just to remind our readers that the chemical point of view is not the only one from which the water question may be regarded:—"Supposing that the greatest chemist in the world places a pint of pure water, absolutely without alloy, at the meal of his fellow man, let us, as medical men, do what the community at large cannot, trace this fluid until it is no longer palpable. Take as a type the pet of the day, the 'working man,' allow him to be a model teetotaller who has taken a vow against alcohol and all fermented liquors. He takes his frugal meal—say water and bread. Trace that meal as far as your physiological imagination can, down the intestinal canal, and into the blood, and fancy, from your knowlege, the affluents thereon. Can 'pure water' be recognised beyond the teeth in this downward course? Mucus, saliva, tonsillary secretion, mucus again and gastric juice, and pancreatic and biliary, all join the ingredients of that simple meal. But let us suppose the working man indulges in the luxury of a bit of beef or mutton, with some of the usual adjuncts; what is the fate of the pint of pure water, which is deemed the grand feature of this excellent fare? Here vegetable and animal matter are joined with pure water to an extent a thousand times beyond the imagination of the pure water theorist. Look even at the condition or risk of the epicure, whose means permit him to indulge in the high-flavoured grouse or daintily managed venison, and suppose him a 'pure water' man, what becomes of the water as soon as swallowed? What about the pleasing adjuncts to these delicious articles of food, and what (to those who are always referring to salts in water) about the common salt which is consumed in quantities palpably larger than those pointed out by the chemist in so-called saline waters?"

Do we, therefore, disapprove of the movement for improving, wherever and however practicable, the condition of our streams? No more than does Sir W. Fergusson himself. But we do most earnestly protest against this movement being made subservient to the vanity and the ambition of any man, or being employed for the consecration of unwise crotchets.

To return to the Rivers' Bill. Dr. Frankland, in his evidence, brings forward the names of a number of scientific men of very various degrees of eminence, who, as he asserts, pronounce his "standards perfectly practicable, and recommend them strongly." Hearsay evidence is not generally considered very reliable. We should like to hear these chemists examined as to their alleged approval of these "recommendations," and called upon to state their reasons for deeming them practicable, judicious, or expedient. We fear that, before such an examination had proceeded very far, Dr. Frankland's admirers would be very much reduced in number. No authority can justify such an assortment of errors and omissions.

The following passage is worthy of public attention:—

"Lord Aveland: Does that sewage farm (Merthyr Tydfil) pay? Dr. Frankland: I should think not. If you were to debit against that farm the cost of draining the land, and the cost of bringing the sewage to it, it certainly would not pay. Even an irrigation farm where you spread the sewage over an enormously larger area of land does not always pay."

Dr. Frankland also believes that if an act which compelled the purification of water—we presume on "recommendation" principles—were put in force, it "would greatly benefit nearly every manufacturer in the country individually."

The gentlemen who gave evidence on behalf of the various manufacturing interests concerned expressed a

very natural doubt as to the practicability of the scheme proposed. It is interesting to observe how their scruples were met. The case of the Alkali Act was duly paraded before the vision of the public. In that instance manufacturers were ordered by the law to do something which had not been customary, and which was generally deemed impracticable, to condense, namely, 95 per cent at least of the hydrochloric acid gas generated in their establishments. They succeeded in doing much more than the law demanded, and that not without benefit to themselves. But it is questionable logic to assume that, because one such piece of audacity proved so splendidly successful, a similar fortune will always await enactments of this kind. Who have been louder than the Rivers' Pollution Commissioners in expressing their conviction of the impossibility of dealing with town sewage by chemical means? Yet the liquid refuse of manufacturers is no less complex, no less dilute. Since their "recommendations" were put forward, moreover, the price of fuel has greatly risen, and an additional difficulty has thus been placed in the way of the remunerative treatment of such refuse.

But space does not allow us to linger any longer over clause 6 and its shortcomings. Other gems await our notice. Clause 15 informs us that, if pollution is proved against any person, judgment shall be given against him, "notwithstanding that it may appear that the particular pollution complained of is not separately appreciable, by reason of the existence of some other pollution in the neighbourhood." This clause gives facilities for a process of *un*natural selection. Small offenders may thus be seized upon, while greater ones escape. This clause, besides, establishes the principle that a man may pollute a river, and incur penalties, by pouring into it water cleaner than the river in question.

Clause 16 speaks of repeated acts which may be held together to cause a pollution, though each act, taken by itself, may not be sufficient for that purpose. This clause is full of doubt, and therefore of danger. Are we to understand that liquids coming within the recommendation standards may, yet, under certain circumstances not named, be held polluting?

Worse still is clause 21. This Act is not to be the sole and all-sufficient method of dealing with the pollution of rivers, but it is to be "in addition to" any powers which existed before. This is simply to create and foster complexity and confusion. Fix your standards high or low, but let the manufacturer know that, when these are fairly obeyed, he is safe. If the Bill is not to be all-sufficient, clause 6 notwithstanding, why pass it? Is not this very 21st clause a confession of worthlessness?

But the end crowns the work. We read with admiration that this Act "shall not affect any outfall or other works of the Metropolitan Board of Works (though beyond the Metropolis), or take away, abridge, or prejudicially affect any right, power, authority, jurisdiction, or privilege of the Metropolitan Board of Works." In other words, the greatest offender is to go scot-free! The corporations of Liverpool, of Manchester, of Birmingham, of Bristol, of Leeds, will find their privileges most disagreeably affected if they presume to pollute their respective streams and rivers. But what is sauce for the goose is not sauce for the gander. Crossness and Barking are still to be left free to pour pollution by millions of gallons daily into Father Thames. This looks very like an attempt to buy off the opposition of the Metropolitan members. But what will be the result upon the provincial cities and towns. If it does not stimulate them to the fiercest opposition they must be more—or less—than human.

One more point must not be overlooked. The Bill, stipulating for the exclusion of waters containing "organic nitrogen" beyond certain specified proportions, says nothing of the manner in which the amount of such organic nitrogen is to be ascertained. The public have a right to demand a guarantee that the process employed shall not be a well-known one, which is almost universally acknowledged to give erroneous results. Manufacturers must not be mulcted in severe penalties according to the results of a fallacious procedure. It is very possible that this Bill, as it stands, may not become law. Unless the "recommendations" are expunged or fundamentally modified, unless it is made a Bill for testing rivers as well as their inlets, and unless the clauses for making it practically null and void are cancelled, it must be our duty to warn both the authorities of provincial towns and all manufacturing chemists to oppose it at every stage of its career. That we need a good Act on the subject is no apology for passing a bad one. The Rivers' Pollution Commission, we are told, expires at the end of this year. It will serve to moderate our regret if its works follow it.

THE IRON ORE OF THE BIDASOA, AND ITS TREATMENT BY CALCINING AND LIXIVIATION.

By Dr. ERNST RÖHRIG, M.E., and ROBERT HAAS.

The iron mines of the English Mining Company in Irun are situated on that part of the Pyrenees which runs alongside of the river Bidasoa, in the Spanish provinces Guipuzcoa and Navarre.

The ores occurring in these mines are less known than those of the province of Bilbao, which are of great renown, chiefly on account of the large deposit of good iron ore at Somorastro.

The ores of the Bidasoa have been worked on a large scale only a few years; this short time has, however, been sufficient to prove the vast extension of the ore and its excellent quality. The ore is particularly fit for the production of Bessemer pig, as it contains no phosphorus, and on the other hand it contains an amount of manganese.

The proximity and easy access to the Bidasoa from all mines of the Company allows a cheap transport of the ore to the railway station at Hendaye; besides which a railway for conveying the ore is in course of construction, so as to afford the means for transporting any quantity of ore from the mines to the various places of embarkation.

Thus the gain by selling the ore is not inconsiderable; it could, however, be increased three- or four-fold if the ore were converted into pig in the neighbourhood of the mines. The ores occur in lodes of steep inclination, and of an average width of 4 or 5 metres.

The lodes are chiefly found in a formation which here occurs in masses, and is termed by Charpentier granite formation. As, however, the mineral contains no mica, and essentially consists of quartz, orthoclase, and hornblende, its proper termination would be syenite. Other lodes of iron are found in siluric rocks adjoining the syenite, and also in limestone belonging to the trias formation.

The ore itself consists almost exclusively of spathic ore, which is usually transformed into brown iron ore in the parts nearest to the surface. The quality of the ore may be judged from the following lists of analyses:—

I. Ores from San Carlos Mines.

(a). Spathic Carbonate of Iron.

Iron	34·27	42·08	39·99	36·75
Manganese	1·82	2·54	3·99	6·05
Sulphur ..	0·09	0·06	0·03	0·04
Silica	—	9·80	5·48	6·87

(b). Brown Iron Ore.

Iron	48·53	51·02	49·83	26·16	16·67
Manganese	3·39	3·84	4·87	13·29	43·13
Sulphur ..	—	0·04	0·03	—	—
Silica	—	9·49	9·44	—	—

II. ORES FROM THE "ALBION" MINES.

(a). Spathic Carbonate of Iron.

Iron	41·23	40·05	38·75	40·20
Manganese	2·77	3·77	3·72	4·00
Sulphur ..	0·15	0·27	1·39	0·64
Silica	7·88	3·44	—	—

(b.) Brown Iron Ore.

Iron	54·63	52·25	52·64	54·20	47·66	52·70
Manganese ..	0·25	0·40	0·45	0·78	1·84	4·44
Sulphur ..	0·04	0·03	0·07	0·08	1·36	0·99
Silica	9·36	12·70	14·30	—	12·32	—

III. ORES FROM THE "THREE CROWNS" MINES.

	Brown Iron Ore.		Spathic Ore.	Brown Ore.
Iron	55·61	56·47	41·67	44·15
Manganese	0·38	0·90	3·70	4·29
Sulphur ..	0·16	0·06	0·05	0·12
Silica	4·09	4·05	3·02	17·32

IV. ORES FROM THE "SAN BENITO" MINES.

Spathic Ore.

Iron	36·88	39·52
Manganese ..	2·71	2·86
Sulphur	0·06	0·06
Silica..	20·53	13·65

The excellent quality of the ore is further proved by the fact that these ores have been worked for many centuries in Catalan forges with good success, and in many places they are still worked.

The above analyses show also that some of the ores contain a considerable amount of sulphur, and although these sulphurous ores form but a comparatively small portion of the whole, trials for removing the sulphur, by means of a suitable calcination and lixiviation, have been made by us. These trials were carried out most successfully. By means of an oxidising calcination we obtained satisfactory results, shown by the following analyses :—

Spathic Ore of San Miguel.

	Raw Ore.	Calcined Ore.
Iron	42·19	54·43
Sulphur	0·54	0·16

Spathic of San Benito.

Iron	36·07	50·34
Sulphur	0·34	0·18

The amount of sulphur remaining in the calcined ore is so small as to allow of a direct smelting of the ore in blast-furnaces, with an addition of limestone, which will remove the last trace of sulphur. Still better results were obtained by treating ores containing a large amount of sulphur, although the calcining oven at disposal was of imperfect construction, having been used formerly for burning lime, and had to be re-constructed for our purposes as far as circumstances would allow.

In order to find out the limit to which sulphur may be removed by a suitable calcination and methodic lixiviation, we have artificially mixed ore, so as to contain 2½ per cent of sulphur. The results obtained by the treatment of this highly sulphurated ore are shown by the accompanying analyses. (See next column).

The lixiviation of the ore has been considered as finished when a sample of water taken from the apparatus for lixiviation, after being acidified with hydrochloric acid, did not give any more reaction with chloride of baryta.

The small quantity of sulphuric acid, *i.e.*, 0·15 per cent, corresponding to 0·06 per cent of sulphur, as shown by analysis III., proves that the lixiviation had not been carried on long enough in the apparatus. We have removed it by a subsequent boiling of the ore in the state of powder, when it was shown that 0·07 per cent of sulphur could not be removed, and remained in the ore. The same result would have been obtained undoubtedly by a further lixiviation in the apparatus. The remaining sulphur, 0·07 per cent, consists of FeS, and is taken as such in calculation in analyses II. and III.

Components.	I. Raw Ore.	II. Calcined Ore. (a). Analysed.	II. (b). Calculated.	III. Lixiviated Ore. (a). Analysed.	III. (b). Calculated.
FeO ..	19·97	—	—	—	—
Fe_2O_3 ..	30·45	73·47	73·73	76·97	75·30
FeS_2 ..	4·74	—	—	—	—
FeS ..	—	0·19	—	0·19	—
* MnO ins.	2·67	—	—	—	—
* ,, s.	—	0·36	—	—	—
† Mn_3O_4..	—	3·22	3·43	3·67	3·29
Al_2O_3 ins.	0·60	0·46	0·71	0·41	0·48
,, s.	—	0·10		—	—
CaO ins.	0·41	0·22	0·49	0·31	0·21
,, s.	—	0·56		—	—
MgO ins.	0·63	0·51	0·75	0·33	0·53
,, s.	—	0·15		—	—
CO_2 ..	14·76	—	—	—	—
SiO_2 ..	14·36	19·75	17·14	17·09	20·79
SO_3 ..	—	1·70	3·75‡	0·15	—
H_2O ..	5·13	—	—	0·43	—
	99·72	100·69	100·00	99·55	100·00
Fe total	43·26	51·55	51·61	53·99	52·71
Mn ,,	2·07	2·59	2·47	2·65	2·37
S ,,	2·53	0·75	—	0·13	—

* Ins.=in insoluble combination; s.=soluble combination.

† As it was not possible to determine the state of oxidation of the Mn, we have taken it for granted that the Mn is transformed, by the calcining process, into Mn_3O_4.

‡ The total amount of sulphuric acid formed out of FeS_2 after half of the sulphur has been evaporated.

To control the lattter analyses, we have made calculations contained in the two columns (*b*), by which we also proved that calcination, as well as lixiviation, has been perfectly rational. Our calculations are founded on the supposition that, under the process of calcination, all the water and carbonic acid are evaporated, while the oxidisable components of the ore take a higher state of oxidation; thus FeO and MnO will form Fe_2O_3 and Mn_3O_4, and FeS_2, losing 1 equivalent S, is transformed into Fe_2O_3 and SO_3.

The small differences found by comparing the columns (*a*) and (*b*) are chiefly founded in the inevitable differences which always arise in taking samples at different times from the same heap, and it may be possible that some mechanical loss of ore has taken place in the process of lixiviation. The analysis II. is composed of two analyses, containing the soluble part and insoluble part of the ore. 100 grms. of the calcined ore has been boiled until all the soluble parts were extracted; their composition is the following :—

MnO	0·36
Al_2O_3	0·10
CaO	0·56
MgO	0·15
SO_3	1·70
	2·87

Total, 2·87 grms. of sulphates, contained in 100 grms. of calcined ore, and if calculated for 100, the following lixiviated salts appear :—

$Al_2O_3SO_3$	11·50
MnO SO_3	25·78
CaO SO_3	47·39
MgO SO_3	15·33
	100·00

or very nearly a salt composed of 1 equiv. Al, 5 equivs. Mn, 10 equivs. Ca, and 4 equivs. Mg, if calculated on the foundation of their equivalent weights. The amount of

insoluble components (*vide* Table, "ins.") was found by deducting the soluble components from the total analysis of the calcined ore.

It was not possible to ascertain the total quantity of soluble salts and their weight in a direct way, as part of the salts loses its composing water at a lower temperature, and as the sulphates of alumina and manganese are decomposed at a higher temperature. However, we ascertained that sulphate of lime first separated, when boiling the lixiviated salts to dryness.

The lixiviation had a weak, sour reaction, as sulphate of alumina has this property even as a neutral salt.

The determination of sulphur was made in all the three analyses with especial care. We applied the dry way (with soda and saltpetre), and also the wet way (with hydrochloric acid and chlorate of potash), and our figures represent the average of various analyses. Chloride of iron was removed from the solution before adding the chloride of baryta, which was done to the solution in a boiling state; the solution was kept boiling for half an hour, and kept for twelve hours more at a temperature of about 40° before the precipitation of baryta was filtrated.

The analysis of the soluble salts proves the interesting fact that no iron whatever has entered into solution, as is generally supposed, although in the present case sulphuric acid, in sufficient quantity for the formation of vitriol of iron were at disposal.

The same fact took place in the calcination of other kinds of manganiferous ores; in all cases, not a trace of iron could be ascertained. The presence of manganese, together with that of Ca, Al, and Mg, seems to prevent the formation of sulphate of iron, in case these bases be present in sufficient quantity to neutralise the SO_3 that has been formed.

The most favourable result of having reduced, by the calcining and lixiviating processes, the original amount of sulphur in the raw ore of 2·53 to 0·75 per cent and 0·07 per cent respectively, we think must be attributed to the presence of Mn and Ca in the ore; and the behaviour of manganiferous ores of the Bidasoa during roasting makes it probable that manganese acts, in the calcining process, for the removal of sulphur, in a similar manner as it is known to act in the various iron and steel smelting processes.

We intend to make comparing trials with ores rich in sulphur and free from manganese at the same time.

Irun, Sept. 1, 1873.

SEWAGE AND THE UTILISATION OF ALUM SHALE.

By SIDNEY W. RICH.

That the purification and utilisation of sewage is still a problem requiring solution is known to most persons; it is, however, not so well known that unnumbered tons of a material which is well suited to break the back of the difficulty now lie waste—I speak of the alum shale cropping up at Whitby, Guisborough, and in other parts of England and of Scotland. This shale has long been used for the manufacture of alum and epsom salts, but the process employed being a crude, wasteful process, the works have one by one broken down, being unable to bear the competition with more modern works and more modern processes developed at Manchester, Newcastle, Goole, and elsewhere. Nevertheless, this shale is peculiarly adapted to the manufacture of alumina salts, and, consequently, is likely to render material assistance at all events towards a partial solution of the sewage difficulty.

The final opinions of the British Association Committee on the Utilisation and Purification of Sewage embraced the statement that, "by properly conducted sewage irrigation, a solution is afforded to the question of sewage utilisation," while, at the same time, "a precipitation process, or some clarifying process, may be found useful." Few people will deny that some clarifying process should be applied to the sewage before it is run on to the land; indeed, it is probable that, if effluent water alone were used for irrigation, choking of the land would be less likely to occur, and, consequently, the land would take more sewage and cause less annoyance. Fewer people still will deny that, if the sewage is to be run into a river, it is still more necessary to employ an efficacious precipitation process, in order that the effluent water may be as free as possible from obvious impurity. In either case a cheap precipitating agent is required, and there can be no doubt that in some form of soluble alumina only can we find such an agent. Practically, if the effluent water is to be used for irrigation purposes, a very small quantity of alumina will sufficiently clarify the sewage; on the other hand, if the effluent water is to flow directly into a river, a large quantity must be used. To test the results afforded by these different degrees of clarification, I have experimented on a very large scale at the Tottenham Sewage Works, and I find that, by reducing the amount of soluble alumina to the lowest figure compatible with the production of a clear effluent water, a deposit may be easily obtained, containing, when dry, 3 per cent of ammonia. I obtained, however, a different result when I aimed at getting an effluent water *as pure as possible*—the quantity of precipitating material being increased, the ammonia in the deposit was proportionately decreased. I would therefore clarify the sewage more or less perfectly according to its immediate destination; if irrigation is in view, a double profit may be expected—that on the application of the effluent water and that on the deposit. If, on the other hand, perfect artificial clarification is aimed at, regardless of the expense, the loss must be borne. With respect to the deposit, a great difficulty arises—it is by no means saleable. This must, however, be got over by special means in each locality. In dealing with the London sewage, and, wherever any large sandy area is available, it cannot be better applied than to the stiffening of the sand. Containing, as this deposit does, a large proportion of alumina, it is precisely the most suitable material that could be applied to sand. It should be partially dried, and then ploughed in, and the work, if in its first stages a loss, should be considered a national work of reclamation. A sandy tract, stiffened with this aluminous deposit, irrigated with effluent sewage water, and cropped with rye-grass, must, in the course of time, develop into a highly fertile area.

Many schemes are before the public, advocating the use of alumina in one form or another, commencing with potash-alum and ending with raw clay. The proper selection of the specific material may be advanced by a consideration of the requirements. The alumina should be in the soluble condition, and must be in a fit condition for transportation perhaps many miles; it must be comparatively cheap. These considerations alone will show to any reasonable creature the folly of using alum, and even sulphate of alumina at its present price. In a less degree, the unsuitability of clay, whether in combination with sulphuric acid or not, is evident. Sulphuric acid, as such, is far too expensive to be cast away by the ton, while clay becomes impossible immediately the question of transport arises. Where transport is necessary, a concentrated material must be used, and clay can never furnish this. And yet consideration will show that a combination of sulphuric acid and alumina—in other words, that some form of sulphate of alumina—is the only material which meets all our requirements; it contains a suitable proportion of soluble alumina, and is therefore portable, but at present it is dear. It is dear because its manufacture involves the use of sulphuric acid, which is, alone, an expensive manufactured article. These considerations forced themselves on my mind eighteen months since, and I trust I shall not be accused of the endeavour to push a pet theory if I give an account of my subsequent action in the matter. Convinced of the necessity to

manufacture sulphate of alumina without the use of sulphuric acid, I set to work and experimented on the aluminous shale at Guisborough. As a result of my experiments I found that at a suitable temperature the burnt shale combined with sulphurous acid gas, provided air and moisture were present, sulphate of alumina being formed. To carry this out practically, I built a brick cell 18 feet high, and caused the shale immediately as it burnt, and while still hot, to sink into the cell. By withdrawing the burnt material from the bottom, and continually renewing the heap of burning shale at the top of the cell, I was able to keep up a continuous passing of material down the cell. I now caused the introduction of sulphurous acid gas at the bottom of the cell from a pyrites-burner; air and moisture were introduced at the mouth of the cell. Owing to the high temperature within, and to the joint presence of the several agents, the whole of the sulphurous acid gas was converted into sulphuric acid, and, in consequence, masses of the burnt shale came down in large part converted into soluble sulphate of alumina. This invention forms the subject of a patent, whilst an improved method of lixiviating the crude sulphate of alumina forms the subject of another patent. The method of lixiviation employed involves the treatment of the hot crude sulphate with water, in tubs which run on an inclined tram, and work on the principle of the lixiviating vats for alkali. The crude sulphate being lixiviated immediately it is removed from the cell, and while it is at a high temperature, the liquor becomes boiling hot, and may be drawn off at a highly concentrated point; indeed, very little expense is involved in the matter of fuel and evaporating-pans. The net result is that sulphate of alumina may now be profitably manufactured on the large scale for 25s. or 30s. a ton.

In the event of a cheap sulphate of alumina being utilised for sewage purposes, I would recommend the value of the article to be determined by the percentage units of soluble matter precipitable by ammonia, irrespective of its precise character, *i.e.*, of the proportion of soluble silica, precipitable lime and magnesia salts, &c., provided there were no more than some specified maximum of oxide of iron present.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 201).

LECTURE V.

On the Energy of Electricity, with Especial Reference to the Measurement and Utilisation of it.

THE energy of electricity is being manifested in phases new to men day by day. That which in the early part of the present century was unknown is now so well known as to win neither surprise nor notice. The telegraph which girdles the earth—the electro-deposition of metals—the light which pales our brightest—the power which melts the most refractory metals (for I have seen a square bar of iron a foot in length, and about three-eighths of an inch on the side, fused into drops by a current of electricity in less time than this narrative has occupied)—these have been handed down by science to promote the commercial and social welfare of mankind.

What remains to be done by this energy, so recently harnessed, and as yet only partially trained, is beyond our present ken; but that it will—or, at least, that it can—be developed in a sufficiency to supply our coal-fields when exhausted, and take upon itself all that coal, and wind, and water now give of kinetic energy, no one who has watched the progress of the past need doubt; this, too, quite irrespective of the view that owing to the quantity of zinc consumed electricity can never compete with coal in producing the same results. There is every reason to expect that long ere the coal-fields are exhausted the tidal waves on our coasts will be supplying light enough and heat enough, and, therefore, power enough, for the requirements of Great Britain and Ireland.

Propositions better established than that which asserts electricity to be non-producible from sufficiently economical sources have faded into oblivion.

The energies of electricity are manifested whenever there is a molecular disturbance within or amongst bodies. Whenever any change takes place in anything whatever, and amongst any molecules whatever, an electric current is produced, and if not necessarily manifested to us, still it always is present. Probably there is not a single act of our lives, and it may be not even a thought in our heads, which is not associated with an electric current.

Kindly understand that the lecture is on the energy of electricity, and, therefore, time must not be occupied in describing instruments. Galvanometers are now-a-days made so delicate that if you lay one finger in one trough of salt water, and another in another, and simply tighten the muscles of one arm, a current of electricity passes through the galvanometer and deflects the needle. We cannot raise our hands to our head without setting free a current of electricity, and in that current is energy. Its energy is manifested in the moving of the galvanometer needle. How much of that energy is merely the balance between two energies of large amount—how much is not manifested, owing to the sluggishness of the instrument and from other defects, we know not, but that some is thus interfered with there is very little doubt. We usually speak of a galvanic battery as being formed of zinc and copper, or of metals in chemically different relations to a liquid; if, however, you take a piece of ordinary copper bell-wire, and connect the two ends of it to the galvanometer, then cut it in two with a pair of scissors, and dip each cut end into salt and water, or put them into your mouth, an electric current passes, and the galvanometer shows that there has been some species or other of molecular disturbance which has caused a manifestation of electrical energy.

This energy of electricity becomes kinetic when it is allowed to pass freely. For example, in any bodies which are quiescent, it is kinetic, but it is potential when resisted. If, for instance, a current of electricity passes along a wire and the action is resisted, the wire becomes hot. If it passes through any compound body, as, for instance, water, then it is resisted, and the water is immediately decomposed. Consequently we are dealing to-night with an energy manifested in molecular disturbance, and having both a potential or stored-up power, and a kinetic power in motion. The question now is, how is this energy to be measured? for the subject of the lecture this evening is a mode of measuring the energy of electricity.

Towards the middle of the last century (about 1746) the first electrical machine was made. In 1650, Otto Guericke, to whom we are indebted for the air-pump, suggested the scheme, but Hawksbee was the first to make one. His machine consisted of a ball of sulphur, afterwards altered to a ball of glass. The hands were employed to rub it, and a large fly-wheel, about 6 feet high, was employed to turn it. Silk threads from the ceiling held what we now call the conductor; and by the exercise of a very large amount of mechanical power they were enabled to get a small spark, to the surprise of all, to the curiosity of many, and the dread of not a few. After that we come to the plate machine, which is arranged, as you are aware, with cushions; still we have those sparks which were supposed to have much energy in them. We then pass on from the glass plate machine to the vulcanite plate machine. Here is a vulcanite plate, and, as you are aware, by rotating it between cushions, the electricity is gathered upon this conductor. You see this large wooden ring—that was suggested by Winter

* The Cantor Lectures, delivered before the Society of Arts.

the object of it was, somehow or other, we do not know how, to condense the electricity, and to convert what might be a fine line spark into a solid whitish spark. How this ring acts, and the whole history of this machine, would be quite sufficient matter for one lecture; but that with which we are now concerned is not how to produce such phenomena, but how to attempt to measure the energy of the electricity which these machines, and other means, can develope. I scarcely need tell you that it is not, in any sense of the word, an electrical lecture in which we are to be engaged this evening, and these apparatus are only here as illustrations of the operations. Sparks pass from the conductor, and are usually charged into a jar of this kind—a Leyden jar. That was first done in the year 1746. The jars were charged and discharged, and although great shocks were felt, yet no measure was taken, and it was supposed that in the shock consisted the energy of electricity.

Now, the mode in which electricity thus presenting itself was ultimately measured was by a small jar of this kind, called a unit jar. This unit jar is in all respects the counterpart of the Leyden jar, only made smaller, and one is here mounted on glass and brass rods. There are two brass balls, one connected with the inside of the jar and one with the outside, which balls can be set at any distance apart. The inside of the jar is charged from the electrical machine, and as soon as it is sufficiently charged, according to the distance of the balls from one another, a spark passes. So passing, spark after spark enters the larger jar, and if we count the number of such entering we have settled what was supposed to be the measure of energy contained in the large jar. We may put in 10, 20, 30, or 40 charges. It will be very obvious to you, however, that these unit jars vary. The same jar is always alike, but you cannot make two exactly alike. Even if this could be done, the state of the atmosphere and other surroundings would so influence the passing electricity that accurate comparisons and conclusions could not be made. Moreover, these jars vary on the surface, and in the character of the glass, and in other ways; consequently this mode of measuring energy must necessarily be a failure. The unit jar, therefore, has fallen into complete disuse.

Hitherto the mode of producing the electricity to be measured has been by friction. Now, here is a machine, consisting of a thin circular vulcanite disc, capable of being put in rapid rotation, but there are no rubbers or other articles in contact with the plate. It is called a Bertsch machine. Here are three segments of thin vulcanite; one of these is rubbed with a piece of dry silk or fur, and, being slid in prepared grooves, the faces of the segment and rotating vulcanite are about one-quarter of an inch apart. These two other segmental pieces can be slid behind the first one; if the room and the atmosphere were not so damp we should probably get a 4-inch spark from this machine. One segment is rubbed, and placed about a quarter of an inch from the disc, and by a process of induction, when it is rotated, there is a noise as of much electricity being brought forward and gathered by the conductor. Again, we have here no quantity of electricity—we have no kinetic energy. The difference between energy as it is used, speaking electrically, and intensity, as it is also used, speaking electrically, is this, there may be great intensity and little or no quantity—no power, in the proper sense of the word. For example, if a piece of iron were taken and formed into needles, and if those needles were placed points downward upon the hand, and a small weight upon them, we should find that piece of iron was possessed of great intensity; but if this iron in rough block form, with any weight upon it, be placed upon the hand, although there be a very much larger quantity of iron, yet there is little intensity. In such a sense the distinction is drawn in electricity between quantity and intensity. There is great penetrative power in electricity obtained from this machine, but there is no quantity of electricity moving, and upon the quantity in motion depends our ability to get energy. If all our iron appeared in the form of needle-points we should do very little with it.

There is another matter, also peculiar to electricity of this character, compared with the uses to which iron is now applied. Here is a small glass flask with crumpled pieces of tin-foil in it. If this flask were coated on the outside, as a jar is, the amount of intensity and the shock that would be given by it, would be equal to what might be obtained from that large jar, for this reason, the electrical balances between the inner superficial metal surface and the outer coating of the jar depend upon the intensity on these two. Electricity of this character rests upon surfaces only; electricity of that other character, with which we are more concerned, enters below the surface, and may be said to reside and travel within the body. Whatever, therefore, may be the number of, say, square inches of surface within the jar, the electricity upon the whole of them would be balanced by electricity of equal intensity upon an outer surface covering the jar only. This may be illustrated by a reference to the large quantity of water contained in a dock for ships. It is supported or kept at its level by a gate which in no respect is stronger than would be required for a dock of the same depth containing not one-tenth of the quantity of water. So with what is called the hydrostatic paradox, also so with Bramah's hydraulic press, and so with this little jar. There may be a large quantity of electricity within this jar if it have a large surface on which to distribute itself, and then it will be balanced or kept in equilibrium by a smaller surface on the outside charged to the same intensity.

The electricity here has been produced through physical exertion. We found, however, the other night that there is no physical exertion so great as that which takes place between the molecules of different bodies when chemical affinity is allowed to operate. If, therefore, instead of getting molecular disturbance in the muscles of our arms by turning these handles, we produce molecular disturbance between the ultimate atoms, or molecules of matter, forces are called into play as far beyond the power of our arms as those of the most colossal steam-engine are beyond the power of a mouse. By chemical arrangements we are enabled to obtain electricity of a totally different character from that hitherto noticed—so different that there is little similarity between them, excepting a common name. In fact, the earlier attempts at telegraphy failed in consequence of the promoters using electricity produced by machinery such as this—an electricity which is possessed only of intensity, and not of that energy consequent upon quantity.

(To be continued.)

OBITUARY.

CRACE-CALVERT.

We record with deep regret the death of Dr. F. Crace-Calvert, whose contributions to chemistry have so frequently enriched our pages. Crace-Calvert spent the early years of his life in France. After his return to England he became Honorary Professor of Chemistry in the Royal Institution of Manchester, which position he continued to hold up to the time of his death. In 1850 he was also Lecturer on Chemistry in the Pine Street Medical School, Manchester, an appointment which he does not seem to have held later than 1855. In 1859 he was elected a Fellow of the Royal Society. He was also a Corresponding Member of the Academy of Sciences of Turin, Honorary Member of the Pharmaceutical Society of Paris, and Corresponding Member of the Industrial Society of Mulhouse. He died on the 24th inst., at the age of 54. For many years we enjoyed the pleasure of his friendship, and few can give more able testimony to his worth as a chemist or his faithfulness as a friend.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, September 29, 1873.

New Researches on the Analysis and Theory of the Pulse in the Normal and Abnormal States.—(Continued.)—M. Bouilland.—The author here treats of lesions relative to the number and force of arterial beats, the rhythm of beats and repose of arteries and of the heart, the absence or temporary suspension of beats of arteries and of the heart, and the supposed abnormal dicrotism of the pulse. [M. Bouley, in a note following this one, points out that it is no new view that the arteries contribute, by their elasticity, to the circulating movement of the blood; having been held by John Hunter, Magendie, Dr. Blainville, and others: but M. Bouilland explains in reply that it is a certain systole or pulse of the arteries, rhythmic like the ventricular systole that he considers new.]

Observations on Subjects Treated in No. 21 of the Memoirs by an Officer of Engineers.—Gen. Morin.—Some facts as to the effects of German fire on the forts of Paris are cited from the work, which appears to be of some value in military engineering.

Note on Magnetism.—(Continued.)—M. Gaugain.—In a permanent magnet the curve representing currents of detachment *(d'arraichement)* sinks very rapidly from the extremities to the heel, where it coincides with the axis. In an electro-magnet the curve is nearly a straight line in the interval between the two bobbins, parallel with the axis of abcissæ, and high above it. The increase of magnetisation from application of the armature is, in the latter, nearly uniform throughout the length of the bar; in the former it is much greater at the extremities than at the heel. The current of demagnetisation, produced on rupture of the inducing current when the electro-magnet is without armature, varies nearly as the intensity of the latter for a given point in the magnet. On the other hand, the current of detachment is about proportional to the square of the inducing current. Hence the relation of the current of detachment to the current of rupture itself varies as the intensity of the inducing current. In a series of experiments cited, the proportion of the two currents of demagnetisation was 62·8 with a weak inducing current, but it may be raised to 100. Again, the increase of magnetism in a permanent magnet from application of the armature is independent of the duration of contact. In the case of an electro-magnet, the reaction from application of the armature is effected in a very short time, but it is not instantaneous. The magnetic state was (under the conditions of experiment) appreciably modified during four or five seconds. M. Gaugain further experimented as to the apparently neutral state of magnets pointed out by M. Jamin; first, sending through the bobbins of an electro-magnet, having armature attached, a current of the intensity 17,980 (measured by a conical multiplier); then, after a few seconds circulation of this, a current of contrary direction and intensity, 8900, for a few seconds. After these operations the iron core does not possess any apparent magnetism, but it has the property of being magnetised more energetically in one direction than the other, when subjected to two equal inducing currents of contrary signs and of less intensity than 17,980. The magnetisation in any case was very slight, but could be measured by the method of currents of detachment. Conformably to M. Jamin's observations the author found the inequality of the two magnetisms effaced as the current approached the intensity of 17,980. The apparently neutral state can be obtained a great many different ways, the iron having different properties in each case. The author supposes a superposition of alternate layers of contrary magnetism, positive and negative. He experimented by sending through the bobbins of an electro-magnet with armature—1, a current considered positive, of intensity 17,900; 2, a negative current, of intensity 11,100; 3, a positive current 5898. After this process the iron has no sensible magnetism, but it has the following properties:—When an inducing current of determinate strength is passed alternately in opposite directions the two magnetisations, positive and negative, are generally unequal, and their relation varies with the intensity of the inducing current. When this intensity is little above 5898, the negative magnetisation is considerably above the positive; with intensity 8606 the two magnetisations are equal; as the intensity continues growing the positive intensity becomes superior; it is much the greater for intensity 11,100; and, lastly, the two magnetisations become equal again for intensity 17,900. To explain these effects it must be supposed that the bar contains two layers of positive magnetism, separated by one of negative.

Zeitschrift fur Analytische Chemie, Zwölfter Jahrgang, Erster Heft, 1873.

Determination of Phosphoric Acid in Baker-Guano and Similar Raw Materials (Malden-, Jarvis-, Enderberry-, Starbuck-, and Howland-Guano).—Dr. C. Gilbert.—A condition necessary for the correct determination of phosphoric acid in those methods where it is finally precipitated with magnesia-mixture, or estimated by means of a uranic solution, either gravimetrically or volumetrically, is that the acid should be present in the tribasic state. In the materials above mentioned the acid is in the tribasic state, but not always saturated with lime, sometimes magnesia and basic water replacing more or less of the lime. In many cargoes of these guanos lumps occur of nearly pure so-called neutral phosphate of lime—

$$\left.\begin{matrix}2CaO\\HO\end{matrix}\right\}PO_5+4aq.$$

sometimes in union with gypsum. Phosphoric acid is generally determined in a hydrochloric or nitric solution of the incinerated, and more or less strongly ignited sample. The half-phosphate of lime on ignition passes into pyrophosphate, which on solution in acids, and even on long digestion at a moderate heat, is not completely re-converted into orthophosphate. This error is most serious in volumetric determinations with uranic solution, and least in cases where the phosphoric acid has been separated with the molybdic mixture; since the prolonged digestion in the nitric-molybdic solution re-converts a large proportion of the pyrophosphoric acid into orthophosphoric. Bunsen's method, on Reynoso's principle, excludes this error, as it requires evaporation in strong, preferably fuming, nitric acid. Fresenius recommends, in his instructions for the determination of phosphoric acid in guano, to fuse the sample with carbonate of soda and nitre, thus at once oxidising all organic matter, and ensuring the solution of all phosphoric acid in the tribasic state. But this advice is neglected in practice. Stohmann even recommends, in his treatise on the commercial examination of manures, to dissolve the ash of guano direct in nitric acid, and to employ this solution in the determination of the phosphoric acid. The author recommends the following procedure:—2·5 grms. of the sample, dried if the manure is in a very moist condition, mixed with four times its weight of a finely-powdered mixture of 2 parts of dry carbonate of soda and 1 part chlorate of potash, which should be kept ready. The

mixing is performed with a glass rod fused round at the end, in a capacious platinum crucible. The dust adhering to the rod is wiped off with a bit of Swedish filter-paper, and added to the mixture in the crucible. The flame applied is small, and is not brought very near, and under these conditions the ignition proceeds quietly without loss. As soon as the contents of the crucible are white the heat is increased, and the material is kept in flux for a quarter of an hour at full redness. When cold the crucible is placed in a beaker covered with about 150 c.c. of water, covered with a watch-glass, and about 30 c.c. of nitric acid, of specific gravity 1·25, are poured down the side into the beaker. The mass dissolves if no clay or sand is present easily and regularly. If silicic acid is present it is removed in the usual manner. The solution is then made up to 500 c.c., and used for the determination of phosphoric acid. The uranium volumetric method he modifies as follows:—100 c.c. are put in a beaker for a preliminary trial. The liquid is rendered faintly alkaline with pure soda-lye, and then made acid again with a little acetic acid. This procedure is preferable to adding acetate of soda. The solution can be at once titrated, as the raw materials in question rarely leave a distinct precipitate of phosphate of iron or alumina undissolved. Solution of acetate of uranium is then allowed to drop into the *cold* solution. The solution of ferrocyanide of potassium is to be prepared fresh daily, or the dry salt applied in powder. In gravimetric determinations of phosphoric acid the author recommends that the magnesia mixture be made without sulphate, which if present is partially deposited along with the double phosphate. The proportions are:—For 1 litre, 101·5 grms. crystalline chloride of magnesium ($MgCl+6HO$), 200 grms. chloride of ammonium, and 400 grms. ammonia of sp. gr. 0·96. In the analysis of materials like ground bones, animal charcoal, and gelatinous bodies, the chlorate of potash in the fusion mixture is replaced with saltpetre. The Baker guano contains 45·93 per cent phosphoric acid; the Jarvis, 36·71 per cent; the Enderberry 44·11 per cent; and the Starbuck, 35·54 per cent. In an appendix Professors Fresenius and Märcker and Dr. Ulex express their approval of Dr. Gilbert's procedure.

Experience in Chemical Jurisprudence.—Heinrich Struve.—A paper on the detection of hydrocyanic acid in poisoning cases.

Detection of Grape Sugar along with Dextrin and Analogous Bodies.—C. Barford.—The author's object was to find a method of readily and certainly detecting small quantites of sugar in presence of a large amount of dextrin. A solution of acetate of oxide of copper, containing a small quantity of free acetic acid. 1 part of crystalline neutral acetate of copper is dissolved in 15 parts of water, and 200 c.c. of this solution are mixed with 5 c.c. of acetic acid, containing 38 per cent of anhydrous acid. A few drops only of the test-liquid are added to the solution in question, the mixture is boiled only for a moment, and if the reaction does not ensue forthwith it is allowed to stand for not more than a couple of hours. If set aside for a longer period without examination the precipitate formed may be re-dissolved. The same test-liquid serves for the detection of grape sugar, not merely along with gum and cane sugar, but also when associated with milk sugar. All these three bodies behave like dextrin. Solutions of milk sugar must not be too concentrated or suboxide of copper may be separated on boiling.

Method of Determining Sulphur of General Applicability.—A. Sauer.—This process is adapted for determining the sulphur in coal and coke. The sample is burnt in a stream of oxygen, and the sulphurous acid formed is collected, hydrochloric acid containing bromine. A full description of the process would be unintelligble without the accompanying figures.

Precipitation of Magnesia.—Dr. Mohr.—Magnesia is generally precipitated after lime from an ammoniacal solution which has been kept clear by means of sal-ammoniac by phosphate of soda. The precipitate, gelatinous at first, passes on standing into the crystalline double phosphate of magnesia and ammonia. If the liquid is filtered too soon, a further precipitate is formed in the filtrate, and it is necessary to filter again. The case is quite different when, instead of phosphate of soda, a solution of double phosphate of ammonia and soda is employed. A crystalline precipitate appears at once, and in a few moments it is completely deposited.

Contributions to the Qualitative Analysis of Vine Leaves.—C. Neubauer.—The author detected tartar, tartrate of lime, quercetin, quercitrin, tannin, starch, tannic and malic acids, gum, inosit, sugar, oxalic acid, a crystalline body soluble in ether, ammonia, phosphate of lime, and gypsum.

Comparative Determinations of Alcohol.—Dr. A. Kraft.—A lengthy paper on the different methods of determining alcohol in wines.

Prevention of Explosions During the Use of Apparatus for Generating Hydrogen Gas.—Dr. R. Fresenius.

Technological Chemical Gas Analysis. — H. Fresenius.—Both these papers would be unintelligible without the accompanying illustrations.

Volumetric Determination of Zinc.—O. Schott.—In the sulphide of sodium process the author recommends glazed card-paper (containing carbonate of lead) as an indicator.

Detection of Chlorine, Iodine, and Bromine in Organic Matter.—C. Neubauer.—A little oxide of copper is introduced into the loop of a platinum wire, and heated till it adheres. It is then dipped into the substance, or a little of the latter if dry is sprinkled upon it. The loop is then brought into the flame of a gas-burner moderately opened, near the lower and inner margin of the flame. The carbon burns first, and the flame becomes luminous followed by the characteristic blue or green colour.

Detection of Alcohol in Essential Oils.—R. Böttger.

Analysis of Cheese.—Alexander Müller.—This paper is unsuitable for abstraction.

Test for the Fastness of Turkey Red.—Armand Mueller.—Equal weights of the samples of dyed cloth or yarn are placed in equal measures of the following mixture:—10 vols. of alcohol at 96 per cent Tr., and 1 vol. hydrochloric acid at 1·18 sp. gr. Large quantities of the solution are used, and the whole is gently heated on the water-bath to about 50° C. The time is noted when each swatch become discharged. It appears that the greater the amount of alumina in a Turkey red the longer it resists the extracting mixture. The author concludes that the oil is only then serviceable when it has completely passed into that unknown, generally called oxidised, state in which it ceases to be soluble in ether.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 250, October, 1873.

Report on Bloch's Feculometer (Farinometer).—Presented by M. Cloëz.—Potato starch, which is now used in constantly increasing quantities in the manufacture of dextrin and of glucose, is found in various states of hydration, in which the water ranges from 16 to 50 per cent. The intermediate stages are very difficult to identify by their appearance or touch. Bloch's instrument serves to determine the amount of water present in a manner sufficiently accurate for commercial purposes. It consists of a glass tube formed of two parts of different diameters; the lower, 0·220 metre long and 0·016 metre in diameter, is closed at one of its ends; it serves to contain the starch and indicate its value, for which purpose it carries a graduated scale. The upper part fused on to the lower tube serves for a funnel. It is a cylinder 0·180 metre long and 0·028 metre in width, and is closed

above with a glass stopper. To graduate his instrument Bloch has set out with the principle that pure starch, not modified by heat or the action of acids, if in presence of an excess of water combines with a certain quantity of that liquid, forming, according to the author, a hydrate of known volume. After having exactly determined by drying the quantity of moisture contained in a sample of starch, if we take a quantity of such starch supposed to contain 10 grms. of dry farina, and place it in a graduated tube in contact with common spring water or river water, we find after a certain time that it occupies the volume of 17·567 c.c. This is the starting-point for the graduation and the construction of the farinometer. The lower tube should have a capacity of about 20 c.c. 17·567 c.c. are carefully measured into this tube, and the volume occupied by this is then divided into 100 parts of equal capacity. It is evident that each degree represents 1 per cent of dry farina. To make the assay an average sample of the starch is taken, and 10 grms. are weighed and introduced into the tube with common water. It is well shaken so as to beat up and mix the solid matter; then a slender stream of water is allowed to flow along the inside of the upper tube so as to rinse down all adhering particles of the starch. The apparatus is then set aside for an hour or two until the starch is deposited, and does not move if the apparatus is inclined on one side. The number of degrees on the scale occupied by the starch is then read off. This number represents the proportion in hundredths of real starch; if this, *e.g.*, is 76, 100 kilos. of the sample contain 76 kilos. of starch, and 24 kilos. of water of hydration. This is the limit of composition of a commercial starch which does not roll into balls in the hand.

Report on Marine Glue, and on an Impermeable Liquid Glue.—M. Barral.—An account of the uses of two kinds of marine glue manufactured by Madame Audouin. The impermeable liquid glue serves to make troughs of paste-board for photographic purposes, capable of resisting the action of nitrate of silver, and even highly concentrated nitric acid.

Bulletin de la Societe Chimique de Paris, tome xx., Nos. 4 and 5, September 20, 1873.

Use of the Hydrosulphite of Soda for the Titration of Oxygen and Oxidised Compounds, and on Certain Novel Facts Concerning Oxygen.—P. Schützenberger and Ch. Risler.—This important paper, which requires an illustration, will be given entire at an early opportunity.

New Experiments on the Respiration of Fishes.—Dr. Quinquand.—A physiological paper. The determinations of oxygen have been made by the method of Schützenberger and Risler.

Process for Determining the Hæmoglobin in the Blood.—Dr. Quinquand.—An application of the same method.

Researches on Indium.—M. C. Rœssler.—The specific heat of indium requires its equivalents to be 113·4, and leads us to ascribe to its oxide the formula In_2O_3. Hitherto this view has been unsupported by facts, but the author has succeeded in obtaining the alum of indium and ammonium, $In_2(SO_4)_3NH_4SO_4+24H_2O$. This alum is very soluble, water at 16° C. dissolving twice its weight, and at 30° four times. The solution on boiling deposits a white powder. The salt is insoluble in alcohol.

Constitution of Certain New Uraniferous Minerals.—Cl. Winkler.—The following minerals have been found in the Weisser Hirsh mine at Schneeberg, and have been examined by Weissbach:—*Uranospherite*.—Hemispheric brick-red masses which decrepitate on heating, and are resolved into a number of silky needles,—

$$Bi_2O_3,2U_2O_3+3H_2O.$$

Walpurgine, a basic arseniate of bismuth and uranium $(Bi_2O_3)_5,As_2O_5+(U_2O_3)_3.As_2O_5+10H_2O$. On calcination this mineral turns brown, and after cooling appears of a deep orange-yellow, without alteration in the form of the crystals. *Trægerite* (arseniate of uranium)—

$$(U_2O_3)_3As_2O_5+12H_2O,$$

forms yellow crystals, which lose water when heated, and become temporarily of a golden-brown without modification of form. Their yellow colour returns on cooling. *Zeunerite* (arseniate of uranium and copper),—

$$(AsO_4)_2UO_4Cu+8H_2O.$$

This mineral forms fine green crystals resembling chalcolithe, or phosphate of uranium and copper. Chalcolithe from Redruth contains 3 per cent of arsenic acid, whilst zeunerite is free from phosphoric acid. *Uranospinite*, $(AsO_4)_2Ca(UO)_4+8H_2O$, is of a pale yellowish green and corresponds to uranite. If nitrate of uranium is added to a solution of oxide of copper in arsenic acid there appears a turbidity, and green crystalline lamellæ are formed, or, if the solution is hot, a crystalline powder agreeing in composition with zeunerite.

Detection of Tellurium and Sulphur in Ores.—G. Kustel.—To detect tellurium in ores which contain it in the state of telluride of gold the author uses sodium amalgam. The powdered ore is placed in a capsule with a little water and mercury, and afterwards a little sodium amalgam. If tellurium is present the water takes a violet colour. If it contains sulphur the water blackens silver-foil. If sulphide of iron is present the violet colour produced by the telluride of sodium may be masked by the precipitate occasioned. In such cases the water is poured off, a fresh quantity of water added, and the test is re-commenced with a fragment of sodium amalgam.

Reaction of Tellurous Acid.—F. Stolba.—Tellurous acid, mixed with an excess of alkali is reduced by glucose; if the solutions are dilute, and a large quantity of glucose be employed, the whole of the tellurium is deposited as a black powder. Selenious acid is not reduced under the same circumstances.

Apparatus for the Analysis of Gaseous Mixtures.—M. Orsat.—By means of an aspirator, which may be merely a bottle half-filled with water, and connected by a caoutchouc tube to a graduated jar which serves for measurement, and which may be raised or lowered by hand, we introduce into the jar 100 c.c. of gas. Then, by raising the aspirator, this gas is transferred into a first receiver which contains a solution of potassa at 40°; the carbonic acid is absorbed. The decrease of volume is noted. The gases are then transferred to a second receiver, ammoniacal hydrochlorate of ammonia and metallic copper, carbonic oxide and oxygen are absorbed, and a fresh decrease of volume is noted. What remains is nitrogen if the products of combustion are under examination. The volume of oxygen being known, if we deduct the quantity of oxygen which has been introduced along with it, and has served to form carbonic acid and carbonic oxide; then as oxygen is transformed into carbonic acid without change of volume, while it is doubled on becoming converted into carbonic oxide, the joint increase of volume of the oxygen, and the carbonic acid as compared with the initial volume of oxygen, represents half the volume of the carbonic oxide produced. Chlorine and sulphurous acid can be absorbed by means of suitable reagents.

Method of Printing Anilin Colours on Calico.—(*Moniteur de la Teinture*).—A solution of gelatin is prepared containing about 50 grms. to the litre of water. Solution of bichromate is added drop by drop till a straw-colour is produced; the anilin colour is then added, and the mixture thickened with dextrin or with roasted starch. After printing the pieces are exposed for some hours to light, which renders gelatin insoluble in contact with chrome. The gelatin may be replaced by a solution of casein in a small quantity of ammonia.

Reimann's Färber Zeitung, No. 35, 1873.

The Vienna Exhibition.—The display of dyed silks from Lyons is particularly beautiful. A novel feature is

the display of the various dye-wares along with the dyed goods. The paper-hangings in the English department are pronounced unique and splendid.

Dyeing and Finishing Plushes.—The author continues this subject in considerable detail.

Use of Epsom Salts in Dyeing.—In dyeing wool for goods which require to pass under the stocks, it has been observed for some time that an addition of epsoms gives greater permanence to the anilin colours, especially primula and methyl-violet. An addition of sulphurous acid is also found advantageous for the same colours. The colours are brighter and less inclined to rub off.

Cochineal-Red on Cotton.—To 10 lbs. of goods take 10 ozs. of tannin, and dissolve it completely in boiling water. Lay the goods over-night in the solution. Prepare some red liquor at 12° Baumé, and put into a small tub a sufficient quantity to work 2 lbs. of cotton yarn. Work the yarn for ten minutes. Fill up the red liquor to its original quantity, and work 2 lbs. more; and so on, till the whole of the yarn has been mordanted; it is then allowed to dry, with frequent turning. Piece-goods are winced for an hour in red liquor of the same strength. When dry, the goods are passed through a boiling bath of 1 lb. of prepared chalk to every 10 lbs. of cotton, and washed twice. 1 to 1½ lb. of cochineal is boiled out in water; a colour-bath is made up at 40° Reaumur, with the addition of a little flavin, and the goods are worked, raising the temperature slowly to near the boiling-point.

There are receipts for a Nicholson blue, a cochineal ponceau, and a magenta ponceau on silk, the colours for the latter being hydrochlorate of rosanilin and hydrochlorate of chrysanilin. There are also receipts for a claret, a mouse, and a drab on wool.

New Reaction of Saffranin.—If a few granules of the colour are mixed with 2 drops of concentrated sulphuric acid on a porcelain capsule, and stirred, a splendid blue colour immediately appears. The addition of 2 drops of water converts the blue to an emerald-green, and, by continued alternating additions of acid and water almost all the prismatic shades can be produced with remarkable beauty.

Revolution in the Alkali Manufacture.—According to R. Wagner, Leblanc's process is about to be superseded in England, Austria, and Germany. A solution of chloride of sodium is converted by bicarbonate of ammonia into chloride of ammonium and bicarbonate of soda; the latter crystallises out, while the chloride of ammonium remains in solution. This chloride of ammonium is distilled with limestone, and yields carbonate of ammonia, which is converted into bicarbonate by the excessive acid of the soda salt. No sulphur or sulphuric acid is needed. The soda obtained is very strong, and free from sulphur compounds. Plant, fuel, and labour are economised, and the escape of noxious gases is at an end. (As soon as we see this system at work we will examine its probable consequences—scientific, sanitary, and commercial.

NOTICES OF BOOKS.

Ville de Bruxelles, Assainissement de la Senne. Utilisation des Eaux d'Egout de l'Agglomeration Bruxelloise. Usines de Haeren, Irrigation des Plateaux Sablonneux de Loo et de Peuthy. Par LEON DEROTE et CHARLES VAN MIERLO. Bruxelles: Baertsoen et Cie.

WORKS on sewage and its utilisation are becoming almost as plentiful and as agreeable as sewage itself. The pamphlet before us does not attempt to throw any new light upon this vexed question of modern times. Its authors, two "engineers of bridges and highways," content themselves with the easier task of repeating the questionable, or more than questionable, statements which circulate in England, and allowing them to mislead their countrymen. Had they, like the Prussian commissioner, Lefeldt, come and seen with their own eyes, we must, in common charity, suppose that their reports and conclusions would have been very different. Amongst the grosser errors, we find a statement that MacDougall's process—disinfection with sulphite of magnesia and carbolate of lime—has proved a failure. The fact is that the Carlisle irrigation-plot, where the sewage undergoes a preliminary treatment with these materials before being admitted upon the land, is almost the only farm of the kind which has neither given rise to complaints of nuisances nor proved a nursery of parasites. Whether it has proved a commercial success we are unable to state, but if not it has merely shared the common lot of irrigation-farms. With reference to the sanitary effects of irrigation-farms on their vicinity, a very important piece of evidence has come to light in a "Blue-book" lately issued, entitled "Progress of India for the Years 1871 and 1872," drawn up by C. R. Markham, C.B. We find it here stated that as early as 1847 an epidemic which was then experienced in the north-western provinces was more general and more severe than elsewhere. A committee of investigation recommended that irrigation should not be brought within 200 yards of the villages, and that a double row of trees should be planted round as a barrier. Now it is very true that nuisances of all kinds are less formidable in Belgium or in England than under the sun of India; But, on the other hand, in India irrigation is conducted with clean water, and is only applied when the rain-fall is deficient. If under such circumstances it is pernicious, how much more will this be the case when the land is irrigated continuously, and with offensive water. If a sewage-farm requires to be encircled with an uninhabited district, the expenses of the system, formidable enough already, will be still further augmented. We trust that our Belgian friends will not suffer themselves to be misled, Let them procure M. Lefeldt's pamphlet, and contrast its revelations with the loose statements of Messrs. Derote and Van Mierlo, and they will hesitate before committing themselves to irrgiation schemes. The charge against precipitation, that it was unable to purify sewage, has been so strikingly refuted that it is tacitly withdrawn. Even the last ground of its opponents, the alleged worthlessness of the deposit as manure, is giving way before the irresistible logic of facts. Perhaps such manures *ought* not to produce remunerative crops, but they do, in spite of our theories. We cannot help saying that if Messrs. Derote and Van Mierlo will in future leave chemical questions—such as the treatment of sewage—to chemists, it will be better both for their own reputation and for the public.

MEETINGS FOR THE WEEK.

MONDAY, Nov. 3rd.—Royal Institution, 2. General Monthly Meeting.
THURSDAY, 6th.—Chemical, 8. H. Grimshaw and C. Schorlemmer, "On the Œnanthylic Acid and Normal Heptyl Alcohol." D. Howard, "On the Optical Properties of some Modifications of the Cinchona Alkaloids." J. B. Hannay, "On the Expansion of Carbon Disulphide, and the Action of Iodine Trichloride upon that Substance." W. F. Donkin, "On the Estimation of Nitrates in Potable Waters."

Analysis of Food, Water, and Air.—Mr. WANKLYN has opened a Laboratory at 117, Charlotte Street, Fitzroy Square, and is prepared to give Practical Instruction in Chemical Analysis to Medical Officers of Health, and to persons proposing to undertake the duties of Public Analysts under the new Act.

Two Courses of Lectures on Geological MINERALOGY will be given at KING'S COLLEGE, LONDON, by Professor TENNANT, to which the public are admitted on paying the College fees. One Course is given on Wednesday and Friday mornings, from 9 to 10 o'clock, commencing Wednesday, October 8th, and terminating at Easter, 1874. The other Course is given on Thursday evenings, from 8 to 9, commencing October 9th. The Lectures are illustrated by a very extensive collection of specimens.

Practical Instruction in Mineralogy and Geology is given by Prof. TENNANT, F.G.S., at his residence, 149, Strand, W.C.

SUPPLEMENT
TO
THE CHEMICAL NEWS.

Vol. XXVIII. No. 727.

ESTIMATION OF SULPHUR IN IRON AND STEEL.

By T. J. MORRELL.

The more common method of estimating sulphur in iron and steel consists in acting on the metal with sulphuric or hydrochloric acid, and precipitating some metallic sulphide by the evolved sulphuretted hydrogen. It would be a desideratum, in point of time, if this sulphide could be directly weighed.

By passing the evolved gases through an ammoniacal solution of cadmium oxide (or a solution of sulphate to which an excess of ammonia has been added), a precipitate of cadmium sulphide is obtained, which can be at once collected upon a small filter, dried at 212° F. and weighed.

The phosphoretted hydrogen, evolved in a solution of the metal together with the sulphuretted hydrogen, causes no precipitate in the solution.

The presence of ammoniacal salts would also prevent any precipitation of carbonate of cadmium by the traces of carbonic acid in the air drawn through the apparatus by the aspirator after the metal is dissolved. However, the aspirated air could easily be passed through potash solution, to remove its carbonic acid.

To prevent the precipitation of oxide of cadmium on the filter, the precipitate should be washed with distilled water containing diminishing quantities of ammonia.

If, in very accurate estimations, it is necessary to estimate the minute quantity of sulphur left in the solution and residue of the metal, this can be done as usual and added to that found as above.

Five test analyses of a piece of Bessemer steel known to contain 13 per cent of sulphur, gave as follows:—(1) 0·124 per cent; (2) 0·125 per cent; (3) 0·137 per cent; (4) 0·125 per cent; (5) 0·124 per cent.—*American Chemist.*

Cambria Iron Works, Johnstown, Pa.

ON CHLORIDE OF MERCURETHYL.

By J. M. MAISCH.

This compound, it appears, has recently been introduced in Europe into medicine, and it is claimed for it that it may be used in the same doses and for the same purposes as corrosive sublimate, over which it has the advantage of not precipitating albumen, no matter in what solution the latter may be, whether as egg albumen, in the serum of blood, in urine, &c. Schering and Co. have introduced it under the name of *Hydrargyrum æthylochloratum.*

It was discovered by Strecker* and by Dünhaupt† in 1854. The former chemist started with iodide of ethyl, preparing therefrom as the first step the iodide of mercurethyl; the process of the latter involves the previous preparation of bismuth-triethyl, which being decomposed by corrosive sublimate, yields the compound in question, besides chloride of bismuth-ethyl. Whichever course is followed, the process, or rather series of processes, are tedious and complicated; but that of Strecker appears to offer better advantages in utilising all the material.

Iodide of ethyl or hydriodic ether = C_4H_5I, was discovered by Gay-Lussac in 1815, and prepared by distilling absolute alcohol with hydriodic acid, and separating the compound from the distillate by water. Serullas‡ subsequently improved the process by using iodine and phosphorus with alcohol, and Personne§ found the use of amorphous (instead of ordinary) phosphorus very advantageous, using again absolute alcohol. The latter process was rendered more practical in 1862 by Reith and Beilstein,‖ who proposed to put 1 part of red phosphorus into 5 per cent of alcohol, sp. gr. 0·83, placing the flask with the mixture into cold water, adding 10 parts of iodine, distilling after twenty-four hours, shaking the distillate with soda solution, and removing the oily liquid which is rendered anhydrous and rectified. Lieben communicated, in 1868, to the Vienna Academy of Sciences, his observations that the chlorides of the alcohol radicals are converted into the iodides on being heated to about 130° C., with an excess of concentrated hydriodic acid. Wanklyn¶ and De Vrij§ have simplified the preparation of iodide of ethyl very much by using absolute alcohol, to which a little more than one molecular weight of iodide of potassium is added, after which dry hydrochloric acid gas is passed into the liquid; or the hydrochloric acid is first passed into the alcohol and sufficient iodide of potassium added afterwards; after twenty-four hours the mixture is distilled, the iodide of ethyl separated by water and purified by washing, drying, and rectifying.

Iodide of ethyl is a colourless oily liquid of 1·93 sp. gr. at 15° C. (60° F.), of a strong and peculiar odour, and boiling at about 70° C. (158° F.) When digested with mercury or some other metals, ethyl compounds of the metals are obtained. In this manner and by taking advantage of the influence of diffused light, Strecker prepares the iodide of mercurethyl, re-crystallising the product from alcoholic ether. It forms then colourless iridescent scales, subliming at the temperature of boiling water, fusing at a higher temperature, of an unpleasant odour, and being decomposed by direct sunlight finally into mercuric iodide; its composition is C_4H_5HgI. If its alcoholic solution is precipitated by nitrate of silver and the filtrate carefully evaporated, crystals or a crystalline mass of nitrate of mercurethyl are obtained, which is readily soluble in water and almost as freely in alcohol.

This nitrate is easily converted into the chloride by adding to the aqueous solution of the former, muriatic acid or chloride of sodium, nitric acid, or, in the latter case, nitrate of sodium being separated in the aqueous solution.

Chloride of mercurethyl has the composition of C_4H_5HgCl: it forms white thin scales with an almost silvery lustre, and of a peculiar ethereal unpleasant odour; it is very sparingly soluble in cold water, little in ether and cold alcohol, but freely in boiling alcohol, crystallising again on cooling; it sublimes at 40° C. (122° F.) without fusing previously, and condenses in thin laminæ; exposed to the air it evaporates completely, and heated in a water-bath it may be fused to a clear oily liquid, which evaporates without leaving any residue. When rapidly heated upon platinum foil it burns with a slight flame, the vapours having a disagreeable odour and a metallic taste. Being very poisonous, it must be handled with great care on account of its ready volatility. Schering regards it as pure if it is readily and completely volatilised, dissolves without residue in boiling alcohol, yields in alcoholic solution but a faint reaction of chlorine, and, with alkali, does not produce a precipitate.

It remains to be seen whether its inactivity upon albumen renders this new claimant for medical favour so

* *Ann. d. Chem. und Pharm.*, xcii., 57.
† *Journ. f. prakt. Chemie*, lxi., 599.

* *Ann. de Chim. et de Phys.*, xxv., [illegible]; xlii., 113.
† *Comptes Rendus*, lii., 928.
‡ *Ann. d. Chem. und Pharm.*, cxxvi., 250.
‖ *Polyt. Centralbl.* 1867, 675.
§ *N. Jahrb. f. Pharm.*, xxxi., 169.

much superior to corrosive sublimate and similar mercurials, that its good qualities would more than outweigh the dangers and uncertainties that must result from its ready volatility at our usual summer temperature.—*Am. Journ. Pharm.*

ATOMS.

Dr. C. R. A. Wright, commenting on some remarks made in an article in the *Athenæum*, writes as follows to that paper:—

In that article you have done me the honour of singling me out (not in the most tasteful manner, perhaps, but that is a matter of opinion) as the representative of a school of chemists, which numbers amongst its adherents many well-known names (as an example of which may be mentioned Sir Benjamin Brodie); the members of this school, though differing amongst themselves on certain details, yet agree on this main point, that they object to view the experimental facts of chemistry and the allied branches of knowledge, *solely* through the medium of one preconceived notion as to the ultimate nature of matter.

Speaking for myself, I fail to see the cogency of the reasons which lead a great number of modern chemists to the impression that matter can only be viewed as being made up of "atoms" of some sixty-five essentially different kinds; these atoms, when connected together in certain ill-defined ways, constituting the "molecules" of which the innumerable compounds now known are conceived as being made up. I admit willingly that this "atomic hypothesis," if once admitted, is in close accordance with very many physical generalisations (*vide* Maxwell's recent lecture on molecules); that it gives a clearer explanation of many chemical phenomena than has yet been afforded by any view based on other notions as to the ultimate nature of matter (*e.g.*, the notion that there is but one kind of primordial matter, all so-called elements and compounds being, as it were, allotropic modifications of this matter differing from one another in the amount of energy latent per unit of mass); and that, directly or indirectly, it has done immense service in extending the bounds of knowledge: but, notwithstanding the assertion of the President of the British Association, that there has not been shown to be "any inconsistency in the atomic theory, nor in the conclusions to which it leads," I yet venture to think that this "atomic hypothesis" is not capable of giving a clear explanation of many chemical phenomena now known to us, and that it is not consistent with other so-called Laws of Nature (*i.e.*, hypotheses that meet every case yet propounded by experiment or predicted beforehand).

To take a single case: there is no hypothesis that better deserves the term "Law of Nature" to be applied to it than Newton's fundamental postulate, that two very small portions of matter (and *ergo*, two atoms) attract one another with a force proportionate to the product of their masses, and inversely proportionate to the square of the distance between them. I fail, however, to see how the motions of molecules amongst themselves in diffusion, expansion, friction, &c., are explained in accordance with Newton's hypothesis; nor do I see how the evolution of definite quantities of heat during chemical reactions (*i.e.*, the transformation of certain amounts of atomic motion into molecular motion), and many other analogous phenomena, are accounted for by this "law of force" regulating the mutual action of atoms on one another. On this point I may be in error, if so, I am open to conviction, and will willingly recant my objection to the atomic hypothesis on this score when it is shown that the same hypothesis which accounts for the motions of celestial bodies will also account for those of ultimate atoms, the existence of such atoms being assumed.

Even then, however, I should still retain the conviction, which I have elsewhere expressed, that in teaching the science of chemistry it is preferable, first, to enumerate the facts in language independent of any hypothesis, and then to enunciate the various hypotheses that have been and are held, showing how far each is in accordance or contradiction with the observed facts; rather than to mix up from the outset one particular hypothesis with the facts, so as finally to impress on the mind the manifestly erroneous conclusion that the facts have no existence apart from the hypothesis that more or less clearly explains them.

The President of the British Association states that the objectors to the atomic theory "are unconsciously guided by it." It may be within the memory of such of your readers as are interested in this matter, that some little controversy on this subject was carried on last year in the pages of the *Philosophical Magazine*. This ceased on my part from a conviction of the uselessness of continuing discussion with an antagonist who persistently ignored the main point at issue, viz., the distinction between the meaning attached to the phrase "atomic theory" by Dr. Williamson and his disciples, and that applied to the term "atomic hypothesis" by myself; the former phrase being employed to indicate not merely what is commonly understood as a hypothesis, but also to connote a large number of purely experimental generalisations wholly distinct from the hypothesis propounded to account for them. That the atomic hypothesis (as these words are understood by the majority of chemists) is in any way whatever, consciously or unconsciously, involved of necessity in the calculation (from experimental data and arbitrary conventions) of a formula (*i.e.*, a set of symbols indicating in brief certain physical and chemical properties and reactions), is a point that I am wholly unable to see; but, on the other hand, the following quotations (samples of many that might be given as illustrations) demonstrate to my thinking that the habit of mixing up the known and the unknown by using defective language which embodies both forms of idea when the former only should be referred to, is productive of contradictory statements and of unphilosophical modes of thought.

"The so-called Law of Multiple Proportions has no existence apart from the Atomic Theory." (Williamson, *Journ. Chem. Soc.*, 1869, p. 339.)

"The Law of Multiple Proportions, being founded on experimental facts, stands as a fixed bulwark of the science, which must for ever remain true; whereas the Atomic Theory, by which we now explain this great law, may possibly in time give place to one more perfectly suited to the explanation of new facts." (Roscoe, "Elementary Chemistry," 1st edition, p. 54.)

"This important law (of multiple proportions) which was first clearly established by Dalton, was explained by him by means of his atomic theory." (Miller, "Elements of Chemistry," vol. i., p. 15, 1st edition.)

"The atomic theory . . . . is the very life of chemistry." (Williamson, *loc. cit.*, p. 365).

Sir Benjamin Brodie "agreed with Dr. Odling when he said that the science of chemistry did not require or prove the atomic theory." (*Ibid.*, p. 440.)

It is scarcely necessary to point out that the statements of Dr. Williamson are diametrically opposed to the juxtaposed quotations; that the first statement is in opposition to the opinion of most other chemists; and that these discrepancies arise from the abnormal meaning attached to the term "atomic theory" by Dr. Williamson.

For the reasons above stated, I have no wish to re-open a controversy on this subject; but the way in which my name is referred to in the article alluded to causes me to request space for the insertion of the foregoing remarks, so as to correct any possible misapprehension as to the effect of the eloquent presidential address at Bradford on the opinions of those who object to view facts *solely* through the medium of preconceived notions, no matter how attractive or how useful when judiciously employed.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Annual Meeting, April 29th, 1873.

E. W. BINNEY, F.R.S., F.G.S., Vice-President, in the Chair.

THE following Report of the Council was read by one of the Secretaries:—

The Council have the satisfaction to report that a further improvement has taken place in the financial position of the Society, the Treasurer's account showing that the general balance on the 31st of March last was £407 1s. 4d., against £340 0s. 3½d. on the 31st of March, 1872.

The number of ordinary members on the roll of the Society on the 1st of April, 1872, was 174, and 6 new members have since been elected; the losses are—Deaths, 4; resignations, 4; and defaulters, 3. The number on the roll on the 1st of April instant was, therefore, 169. The deceased members are John Francis, George Cliff Lowe, Samuel Emanuel Nelson, and Joseph Jordan.

Mr. George Cliff Lowe, whose death was the result of an accident in the United States, was known to many of our members for his general and accurate acquaintance with the natural sciences, but more particularly that of astronomy.

Possessing a love of knowledge for its own sake, and a comprehensiveness of mind to deal with other besides purely physical subjects, he took great interest in the leading philosophical questions of the present time, and his opinions were generally to be found on the side of progress. Although not a frequent contributor to the literature of science, Mr. Lowe had an acuteness of perception, combined with a degree of manipulative and artistic skill, which made his co-operation and judgment much valued and sought for by others.

We thus find Mr. Lowe's name associated with that of Professor F. C. Calvert, F.R.S., in a joint paper "On the Expansion of Metals and Alloys," published in the *Proceedings of the Royal Society*, vol. x., 1860. Mr. Lowe was also associated in business with our member Mr. Wilde as an electrical engineer, and suggested to him the plan of exciting a number of electro-magnetic machines by the current from one machine, instead of employing a separate exciting machine for each. With his philosophical attainments Mr. Lowe combined estimable moral qualities, the most conspicuous of which were the amiability of his character and the generosity of his disposition.

Mr. Joseph Jordan, F.R.C.S. Engl., was one of the oldest members of the Society, having been elected on the 19th of October, 1821. He was born in Manchester, and, with the exception of a short period when he was surgeon of the 1st Lancashire Militia, resided in Manchester all his life. He retired from active practice about nine years ago, when he was in the 76th year of his age. His name will be distinctly remembered as the founder of provincial medical schools. As early as 1814, he gave regular courses of lectures on anatomy, with demonstrations and dissections, to classes of medical pupils and students. He was the first provincial lecturer and teacher whose certificates were accepted and recognised by the examining bodies in London. The Apothecaries' Hall began to accept his certificates in 1817, and the College of Surgeons in 1821. In 1826 he built a medical school in Manchester at his own cost, and, besides its lecture hall, provided it with one of the most commodious and best-fitted dissecting-rooms in England, and transferred to it his own valuable museum, containing nearly 4000 anatomical specimens and morbid and other preparations. He subsequently placed this museum in the Manchester Royal School of Medicine. He devoted himself to the arduous duties of a public lecturer for twenty years. On his retiring from the chair, a public dinner was given to him by his friends, in October, 1834, attended by almost every medical man of reputation in Manchester, and a handsome and valuable testimonial in silver plate was presented to him from his friends and pupils.

Mr. Jordan had further claims upon public regard as a large benefactor to suffering humanity by professional unpaid services. In his private practice, extending over more than fifty years, Mr. Jordan ever showed a special devotion to the relief of the sickness and suffering of the poor. His great professional skill, often unpaid, and even supplemented by a liberal purse, and that genuine kindness which ever doubles the value of a gift, won for him the blessings of thousands. Nor was his philanthrophy less conspicuous in official positions. About 1819, he aided largely in founding the Lock Hospital for unfortunate women, of which he was the surgeon or consulting surgeon till he finally retired from practice. He was always a steady benefactor to the institution, in wise counsel and liberal donations. In 1835, he was appointed an honorary medical officer of the Royal Infirmary, and long filled the honourable position of its senior surgeon with the highest credit to himself and with great benefit to the institution and the community at large. Within its walls he often performed some of the greater, as well as the more delicate, operations of surgery; his remarkable nerve and steadiness and precision of hand admirably qualifying him for these duties. He invented a most beautiful little lamp to obtain a magnified view of the membrane tympani and other organs, for which the Society of Arts awarded their silver medal. His clinical lectures in the hospital wards always attracted a large and attentive following of the pupils and students, and a few years ago a very numerously signed testimonial was presented to him by the pupils of the Royal Infirmary for these lectures. He was a most eloquent and interesting lecturer, and his great and long experience enabled him to illustrate his lectures with cases bearing upon the subject, which rivetted the attention and increased the knowledge of his hearers.

Mr. Jordan was a valued contributor to medical science by a new method of treating false joints. A difficult class of surgical cases is presented when the fractured surfaces of bone refuse to reunite, or else unite so badly as to cause great suffering and even loss of the use of a limb. For the cure of these so-called "false joints," and the effecting of a speedy, safe, and satisfactory reunion of the fractured bones, Mr. Jordan, in the year 1854, invented and applied a new and exceedingly simple mode of treatment. His plan was recognised not only by his professional brethren in Manchester, but in June, 1856, the eminent Paris surgeon, Professor Nelaton, in a public lecture to his class, described the method as "a happy innovation, and one capable of receiving numerous applications." The priority of Mr. Jordan's claim to this invention was beyond doubt. Finding, however, that a French surgeon was introducing the method as his own, Mr. Jordan proceeded to Paris in 1860, where he published in French a treatise, illustrated with three plates, entitled "Traitement des Pseudarthroses par l'Autoplastic Periostique," which not only effectually extinguished any rival claim, but comprised a full and clear exposition of the mode of treatment in all its successive stages, and gave to the author a European reputation.

It was at one time proposed that some mark of her Majesty's favour should be solicited by Mr. Jordan's friends, to honour one who had conferred so much credit upon his profession in Manchester, and so much advantage upon the community at large; but the modesty of the veteran self-sacrificing surgeon shrunk from this distinction, and at his instance the movement was stopped.

In the last annual report it was stated, with reference to the benefaction which the late Natural History Society provided for the promotion of the study of natural history in Manchester, under the guardianship of the Literary and Philosophical Society, that the Owens College would at once proceed to endeavour to sell the Peter Street site, to

be delivered up in June, 1873, for money or for rent, as may seem best. In the latter case, it had been agreed between the Commissioners and the College that the College should pay £60 per annum as interest at 4 per cent on £1500 until the principal shall have been paid over to the Society. The Council have now to report that the Peter Street site has not yet been sold, but on the 20th of November last a letter was addressed by Mr. Darbishire to Mr. H. A. Hurst, the treasurer of the Microscopical and Natural History Section, stating that, by an arrangement made on that day between the Commissioners of the Peter Street Museum and the Owens College, the Museum Trust in the hands of the College will pay to the Philosophical Society, for the present, interest upon the sum of £1500 at 4 per cent from that date. The first half-yearly payment will therefore become due on the 20th of May next.

At a meeting of the Council held on the 7th of January last, a committee was appointed to consider and report upon the desirability of incorporating the Society, and of acceding to an application of the Manchester Geological Society for permission to hold its meetings and keep its library within this society's buildings. Resolutions embodying the recommendations of this committee will be submitted for the approval of the members of the Society.

In May of last year, Dr. R. Angus Smith, F.R.S., a vice-president of this Society, attended on behalf of the Society the centenary celebration of the foundation of the Royal Academy of Sciences of Belgium, and a medal has this day been received commemorative of this interesting event.

The following gentlemen were elected officers of the Society and members of the Council for the ensuing year:—

President—James Prescott Joule, LL.D., F.R.S., F.C.S., &c.

Vice-Presidents—Edward William Binney, F.R.S., F.G.S.; Edward Schunck, Ph.D., F.R.S., F.C.S.; Robert Angus Smith, Ph.D., F.R.S., F.C.S.; Rev. William Gaskell, M.A.

Secretaries—Henry Enfield Roscoe, B.A., Ph.D., F.R.S.; Joseph Baxendell, F.R.A.S.

Treasurer—Thomas Carrick.

Librarian—Charles Bailey.

Of the Council—Robert Dukinfield Darbishire, B.A., F.G.S.; Osborne Reynolds, M.A.; William Boyd Dawkins, M.A., F.R.S., F.G.S.; Balfour Stewart, LL.D., F.R.S.; Alfred Brothers, F.R.A.S.; Rev. Brooke Herford.

MICROSCOPICAL AND NATURAL HISTORY SECTION.

April 21st, 1873.

Professor W. C. Williamson, F.R.S., President of the Section, in the Chair.

Mr. John Barrow read a paper "*On the Use of Naphthalin in Section Cutting.*"

I wish to bring before the notice of the members, and those microscopists who are interested in cutting sections of soft or delicate tissues, the use of naphthalin as a support for such tissues in the section cutter.

The advantages obtained by the use of naphthalin over wax and other bodies recommended for this purpose are—A low fusing-point, absence of contraction in the cutter, very little injury to the edge of the knife, and very ready solubility after cutting in benzol or spirit, so that the substance is removed at once from the section without injury.

Naphthalin is a body not very generally known outside the works of the tar-distiller or colour-maker, so that possibly some of the Members may not be able to obtain samples readily, but I shall have pleasure in supplying it to any of our own members.

Professor Williamson recommended an admixture of wax and oil with the naphthalin, and stated that the knife cuts better with this addition; he also exhibited some extremely beautiful longitudinal and cross sections made in this way.

CORRESPONDENCE.

PHOSPHATES OF IRON AND ALUMINA IN MANURES.

To the Editor of the Chemical News.

Sir,—To all farmers and agricultural chemists the real value of soluble and precipitated phosphates of iron and alumina, as compared with that of the corresponding lime compounds, is a question of very great interest. The various native phosphates contain more or less ferric oxide and alumina, free or combined, part of which, during the superphosphating process, is rendered soluble; and the proportion thus dissolved is not inconsiderable when, as at present, the high prices of raw material and labour necessitate the use of as much acid as possible consistent with dryness, so as to leave little insoluble phosphate. The ferric and aluminic oxides are thus more apt to be dissolved along with the phosphates and carbonate of lime.

It is admitted very generally that precipitated phosphate of lime is equal in real value to the soluble form of that compound; in fact, that as soils contain carbonate and humate of lime, the soluble monocalcic phosphate is transformed almost immediately into the very sparingly soluble dicalcic salt. More readily so will the soluble monoferric phosphate revert to the insoluble form under the same circumstances. Whether the soluble iron in manures exists in combination with phosphoric or sulphuric acid is of no moment, as the lime in the soils will so act on monocalcic phosphate and sulphate of iron as to give insoluble ferric phosphate.

Is this precipitated ferric and aluminic phosphate capable of ready assimilation in the soil? Many chemists will point to its comparative insolubility in carbonic acid water as supplying a negative answer, but I am not quite satisfied with this conclusion. In the soil there are many substances besides carbonic acid playing a part in the dissolving of insoluble plant food, such as carbonates of lime and magnesia, alkaline chlorides and sulphates, ammoniacal salts, hydrated silicates, humus, &c. It would be interesting to know whether any experiments have been made to test the point. It is well known that under the influence of water containing carbonic acid all silicates are more or less readily decomposed, the bases going into solution as carbonates and soluble silicates. According to Zöller, soil drainage contains 9·34 to 17·46 grs. silicic acid per 1,000,000 grs. resulting from such action. Is it at all unlikely, might it be asked, that between these products and ferric and aluminic phosphates such a decomposition might arise as would result in the formation of a soluble phosphate? Alkaline silicates decompose these phosphates so completely as to be employed in the quantitative separation of the phosphoric acid from its base, the acid being rendered soluble. In the soil drainage we have, if not alkaline silicates, silicic acid and alkaline and earthy carbonates. Might we not have, in short, silicic acid and a bicarbonate so acting on phosphate of iron as to form a soluble phosphate and silicate of iron? Besides, it is by no means unreasonable to suppose that all soluble phosphates of lime and magnesia applied to the soil become very soon converted into ferric and aluminic phosphates. All fertile soils contain a practically unlimited quantity of active ferric and aluminic hydrates, and analyses of drain-water from various soils show quantities in solution varying from 1·32 to 8·26 parts per million. Here we have the conditions necessary for the conversion—an almost unlimited quantity of the precipitant, and a liquid able to dissolve it.

You have readers in all parts of the country, indeed on both sides of the Atlantic, to whom this question is one of great practical importance, and I shall be amply rewarded for my pains if these remarks should originate a thorough and exhaustive discussion of the subject in your columns.—I am, &c.,

Truth Seeker.

THE CHEMICAL NEWS.

VOL. XXVIII. No. 728.

PRELIMINARY INVESTIGATION OF THE FLUORESCENT AND ABSORPTIVE SPECTRA OF THE URANIUM SALTS.*

By HENRY MORTON, Ph.D.,
and H. CARRINGTON BOLTON, Ph.D.

(Continued from p. 167).

Arseniates of Uranium.

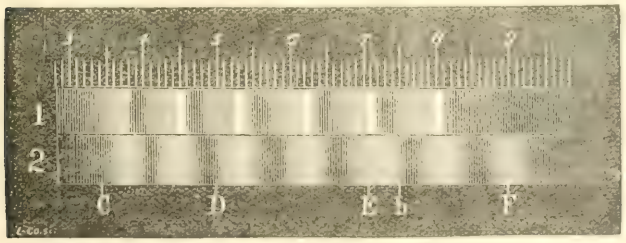
We have examined the following compounds of arsenic acid with the sesquioxide of uranium:—

$U_2O_3 2HO, AsO_5 + 3HO$, Uranic arseniate.
$2U_2O_3\ HO, AsO_5 + 8HO$, Di-uranic arseniate.
$CaO, (2U_2O_3), AsO_5 + 8.HO$. Trano-spinite. } Artificial.
$CuO\ (2U_2O_3)\ AsO_5 + 8\ HO$. Zeunerite. }

From this—which must, however, be regarded as quite too limited a range of experiment for so extensive a deduction—it would seem as if the compound of uranic oxide with arsenic acid were peculiarly fixed and inflexible in the relations which we have now under review. We obtain from these four compounds, at all events, but one spectrum of fluorescence and one of absorption. The three first-named fluoresce with various degrees of brightness, but with the same bands; which are, moreover, very characteristic as compared with those of other salts. Zeunerite shows no fluorescence.

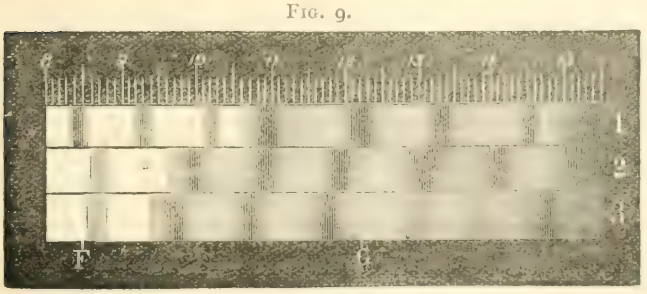
The bands of these spectra have the appearance of flat narrow ribbons, with little of that graduation on the edges which is observable with the other spectra. They appear as if displayed against a partially illuminated back-ground whose uniform tint is broken by a shade on the more refrangible side of each band. 1 of Fig. 8 will give some idea of this.

FIG. 8.



Arseniate and Carbonate.

FIG. 9.



Arseniate and Carbonate.

Absorption-Bands.—All four of the substances named above give the same absorption spectrum, which is distinguished by the same characteristic noticed in the fluorescent spectrum of these salts, namely, the presence of narrow well-defined flat bands. Above 110, where the general absorption begins, the bands not only seem darker, but more blended on their edges. In Fig. 9 the first spectrum will indicate this.

Uranic Carbonates.

Carbonate of uranium, *per se*, does not exist, but in combination with the alkaline carbonates forms finely crystallised, not very soluble double salts. The ammonium salt, $U_2O_3.CO_2 + 2(NH_4O,CO_2)$, has been mentioned; the corresponding compounds of sodium and potassium are obtained by dissolving the uranates of these bases in warm strong solutions of their respective carbonates. The uranic carbonates thus far examined are the following:—

$U_2O_3CO_2 +, 2(NH_4OCO_2)$
$U_2O_3CO_2 +, 2(KO\ \ CO_2)$
$U_2O_3CO_2 +, 2(NaO\ \ CO_2)$

They all fluoresce faintly, their relative brightness being in this order—Ammonio-, sodio-, and potassio-salt, in decreasing intensity. In character the spectra of these salts very much resemble those of the less brilliant double acetates, though they have a stronger light in a narrow line near the more refrangible edge of each band. The positions of the bands of these three salts were not distinguishably different with the methods employed in this examination, and may be seen from 2 in Fig. 8.

The absorption spectra of the ammonio- and potassio-salts are indistinguishable from each other, and from the solutions of any of the three salts; 2 in Fig. 9 shows the absorption spectrum of the sodio-salt, and 3 that of the other salts and of the solutions. The absorption-bands of all these carbonates are remarkably distinct and strong. Stokes first drew attention to them, and suggested their use as a means of recognition (*Phil. Trans.*, 1851, Part II., p. 522).

The thing that strikes the attention at once on seeing the absorption spectrum of the carbonates is the prominence of the three strong black bands at about 105, 115, and 125, which stand out clearly on a light background, the general absorption which commences above this making the higher bands far less prominent.

Oxychlorides.

The salts of this class which we have thus far examined are the following:—

The uranic oxychloride, $U_2O_2Cl + HO$, in various states of hydration not yet determined.

Ammonio-uranic oxychloride,—
$U_2O_2Cl + NH_4Cl + 2HO$.

Potassio-uranic oxychloride,—
$U_2O_2Cl + KCl + 2HO$.

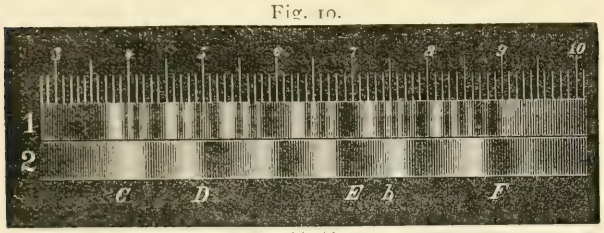
We have not as yet succeeded in obtaining other double salts of this class. The method of preparation is simply to mix the respective chlorides in atomic proportions with water and excess of hydrochloric acid, and place in a desiccator. Sometimes, however, we have found that under these conditions the salts would crystallise out separately, again and again, without forming a compound. It, however, occurred to us that, if a ready-formed crystal of the double salt were placed in such a solution, it would act as a determining centre, around which like material would group itself. In all cases where this plan has since been tried, it has succeeded admirably. Thus, a mixture of ammonio and uranic oxychlorides, which had been standing for months without forming a particle of double salt, yielded a large crop of crystals within twenty-four hours after the addition of a few ready-formed crystals, and then continued to produce nothing but the double salt.

Uranic Oxychloride, $U_2O_2Cl + HO$.—A neutral solution of the above in a desiccator forms an opaque yellow mass having a moderate fluorescence, and yielding the spectrum

* Communicated by President Morton.

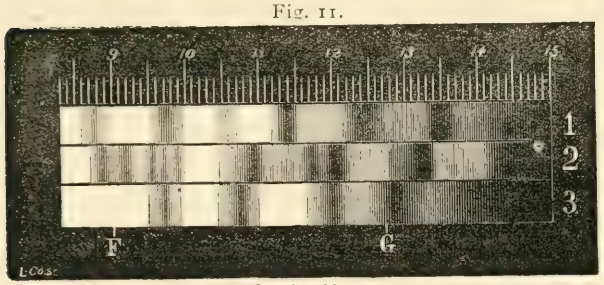
shown in 2 of Fig. 10. This is the substance generally known as the uranic oxychloride, or, in commerce, as uranic chloride. The general character of its spectrum is that which may be regarded as normal to uranic salts—a series of rounded bands terminating most abruptly on the upper edge. In transmitted light, it produces a very marked absorption spectrum, which is shown at 1 of Fig. 11. When the neutral oxychloride is dissolved, it forms a rich orange solution, which has a very great general absorption, and shows some bands; it is almost devoid of fluorescence. The addition of a little hydrochloric acid greatly reduces its colour, and, as with the uranic acetate, clears up its spectrum, which then shows the bands exhibited in 3 of Fig. 11. These same bands are shown by the solutions of the ammonio and potassio double salt, and lead us to conclude that the double chlorides, like the double acetates, only exist as such in the solid or crystallised state. If the uranic oxychloride is allowed to crystallise from a very acid solution in a desiccator, it will form a transparent yellow mass, whose specturum will be of the duplex character indicated in 4 of Fig. 1. This we have little doubt indicates the presence of two hydrates, but it is curious to observe how regularly this spectrum appears whenever the uranic oxychloride crystallises from an acid solution. We encountered it constantly in our unsuccessful attempts to form double salts.

Fig. 10.



Oxychlorides.

Fig. 11.



Oxychlorides.

Ammonio-Uranic Oxychloride, $U_2O_3Cl+NH_4Cl+2HO$.—Though this substance is often so difficult to form, as has been already stated, yet, once formed, if there is a slight excess of hydrochloric acid present, it may be fused, and will crystallise instantly on cooling. If kept in a fused state until a partial decomposition has taken place, an opaque yellow body is formed, which fluoresces very brightly, and yields a continuous spectrum. The normal salt is, perhaps, one of the most beautifully fluorescent in the entire series, and it yields a spectrum equally remarkable. This is represented at 1 of Fig. 10. Each band, as we may say, is here made up of from three to five narrow stripes variously shaded, and this, combined with their rich colouring produces an effect of wonderful beauty. The absorption spectrum of this salt, also of a somewhat composite character, is represented in 2 of Fig. 11.

Potassio-Uranic Oxychloride, $U_2O_2Cl+KCl+2HO$.—This salt, in all its fluorescent relations, so closely resembles the ammonio salt just described, that it is only necessary to note this fact, and say that all its bands are a very little raised in the spectrum, but this difference is too small to be represented in a cut on the scale here employed.

(To be continued.)

ON THE

SPONTANEOUS ASCENT OF LIQUIDS IN VERY NARROW SPACES.

M. Decharme, having a short time since studied the ascent of a large number of liquids in capillary tubes, has recently experimented on the ascent of these liquids in porous paper, with the view of ascertaining whether they ranked in the same order, in this case, as regards height and velocity of ascent. The general results are as follows:—

(1). The ascending movement of liquids in strips of blotting-paper, compared with that in capillary tubes, presents essential differences, as well as numerous similarities. The curves obtained in both cases resemble each other in being sensibly divergent from parabolas, and tending, in the latter part, especially to the hyperbola; but in the blotting-paper the phenomenon is more complex than in the tubes, first from the influence of the hygrometric state of the air, and next because there is sometimes dialysis as well as capillarity.

(2). Each liquid has a velocity of ascent proper to it (papers of constant size being used in each case, and all other conditions being the same). The strips used were 15 or 30 m.m. in breadth, and all from the same sheet.

(3). For different liquids, in the same conditions, the velocities of ascent are not in direct proportion to the height ultimately reached. Thus non-volatile substances, as concentrated acid or saline solutions, and substances largely absorbent of water, sometimes rise slowly; but their movement may continue for days, or even for weeks.

(4). The velocity is, moreover, neither in inverse proportion to the total duration of the movement, nor simply proportional to the density of the liquid. The law depends on other elements, such as temperature and hygrometric state. The annexed curves illustrate these statements.

(5). With capillary tubes, only one liquid was met with which had a velocity constantly superior to that of pure water; it was an aqueous solution of chlorhydrate of ammonia. With the papers, more than forty liquids have been found in a total of 207 (*i.e.*, about a fifth), having both a velocity and a final height superior to that of water. Among these may be cited chlorhydric, nitric, oxalic, tartaric, and citric acids; chlorides of calcium, zinc, and lead; chlorhydrate of ammonia; nitrate, bichromate, oxalate, urate, cyanurate, and oxalurate of ammonia; iodide and bromide of ammonium; chlorate, perchlorate, persulphate, and bioxalate of potash; sulphocyanide, bromide, and cyano-ferride of potassium; sulphate of soda, &c.

(6). For the same liquid, all other conditions equal, the velocity and the capillary height increase with the breadth of the paper.

(7). For the same liquid, and the same breadth of paper, but for strips of a thickness double, triple, quadruple, &c. (multiple strips formed by superposition of several equal strips), the capillary velocity, and the duration of the ascent increase very sensibly with the thickness.

(8). A slight pressure exerted on these multiple strips, better insuring their contact, favours the ascending movement; but, beyond a certain limit of strength, pressure on a sufficiently extended surface diminishes the velocity of ascent, and may even arrest the movement altogether.

(9). The inclination of the paper has a positive influence on the velocity, the length of course run by the liquid, and the total duration of the movement. In every case there is not a proportionality between the heights or the velocities observed and the variable elements, breadth and thickness of paper, pressure, &c.

(10). For all liquids, the velocity of ascent increases with the temperature. Still, if at the beginning of the movement such increase appears, it is presently counterbalanced and ruled by the evaporation, which retards, and

at length completely arrests, the ascent of the liquid, especially where the latter is somewhat volatile. The influence of temperature varies much with the nature of the liquids.

(11). The hygrometric state of the air plays an important part. The more humid the air, comparatively, the greater the velocity and the duration of ascent, and the height finally reached.

What is here said about water applies to many other liquids, especially to those which are very volatile, or to solutions of very hygrometric substances.

Strips soaked, by capillarity, with the following substances, have remained humid during several months in summer :—

Cyanide of potassium.
Sulphocyanide of potassium.
" ammonium.
Chloride of ammonium.
" calcium.
" magnesium.
" zinc.
Sesquichloride of chromium.
Bromide of lime.
Nitrate of lime.
" copper.
Nitrate of uranium.
" silver.
Pentachloride of potassium.
Hyposulphite of potassium.
Hypophosphite "
Phosphite of ammonia.
" potash.
Sulphite of potash.
Bisulphite of potash.
Acetate of potash.
Caustic potash.

The following example gives an idea of the influence of degree of humidity of the air on the ascent of water in strips of 15 m.m. breadth :—

	Time (in hours).									
	½	1.	2.	3.	4.	4½.	5.	10.	20.	40. 51.
Heights in m.m. Air pretty dry..	81	104	125	132	136	137	(End of movement.)			
Air very humid	135	166	189	195	197	198	199	204	214	228 232

Chlorhydric and nitric acids and half diluted sulphuric acid have remained in the papers six or seven days, the temperature being 15° to 20°. Chloride of gold completely blackened the strip, which soon fell to pieces, all remaining humid, however, a long time. The strip soaked with sulphocyanide of potassium remained humid throughout its length, 45 centimetres, during more than six months, beyond which the experiment did not continue.

(12). Another cause often comes to act as an obstacle to the ascent of saline solutions, viz., the crystallisation which takes place in the paper from evaporation of the liquid. An example of this is chlorhydrate of ammonia, which, in moist air and moderate temperature, shows at first a velocity equal, and even sometimes superior, to that of half diluted chlorhydric acid, which has generally the maximum velocity of ascent; but, if the surrounding air is pretty dry, the salt in a day or two crystallises in layers, more or less thick, in the middle part of the strip, thus retarding the movement, and at length arresting it.

This applies also to saturated solutions of crystallisable hygrometric substances, which, without having the velocity of chlorhydrate of ammonia, show similar variations.

It results, from these various disturbing influences, that the ascending movement of a liquid in a strip of blotting-paper may be modified by external circumstances in such a way that, for a certain number of liquids, the order of velocities of ascent, that of duration, and that of final height, may be reversed.

En resumé, the little volatile, very soluble, very hygrometric liquids, which do not crystallise in the blotting-paper, are those which rise the highest, if not the most quickly.

The order of capillary heights, that of velocity, and that of total duration, may therefore be, and in fact are, quite different for the same liquids experimented on successively in capillary tubes and in strips of blotting-paper. The laws governing the two phenomena are different.

It appears, from experiments made on a great number of liquids, differing much both as to chemical composition and physical properties, that with capillary tubes the aqueous solution of chlorhydrate of ammonia and water are in the first rank for velocity and final height; while in strips of blotting-paper these two substances are surpassed in both respects; in the second, especially, by dilute acids, alkalies, and several potassic, sodic, calcic solutions, &c. Further, in strips of paper, chlorhydric acid has the greatest velocity, and generally reaches the maximum height. Silicate of potash, which, with capillary tubes, stood between glycerin and olive oil, is here at the very bottom of the scale; its movement is almost *nil*; it only, indeed, reaches about 4 m.m. height in the blotting-paper.

From the preceding results relating to ascent of liquids in multiple strips, the following inferences are drawn :—

(1). They explain how liquids, water in particular, with matter held by it in solution, rises to such great height in porous building materials of a house, where the foundations rest in a damp soil. It is not an extraordinary thing that, after some time, the presence of moisture and saline matters should be detected, not only on the ground floor, but on the first, and even the second; the liquid ascending in capillary substances of great thickness, and not subject to much evaporation.

(2). The vessels of plants, with their numerous anastomoses, and the permeability of the tissues composing them, are rather comparable to the superposed strips of blotting-paper than to capillary tubes. It is not surprising that the greater part of the saline solutions containing solids fit for their nutrition rise in the vessels to heights much greater than water would do, and also more quickly.

It is not necessary, then, to have recourse to an extreme fineness of vessels, to explain the ascent of liquids in the tissues of plants. It is sufficient to remark that the saline solutions which naturally exist in the soil rise higher than pure water; sometimes to double the height, *e.g.*, the following salts:—Nitrate, sulphate, carbonate, bicarbonate of potash, nitrate of lime, carbonate of soda, chlorides of potassium and of sodium.

A. B. M.

THEORY AS TO THE FORMATION AND PROPERTIES OF OZONE.

By R. LAMONT.

When phosphorus is allowed to oxidise in air, or oxygen gas, phosphorous pentoxide and ozone result. An atom of oxygen cannot exist in the free state, but a molecule can, which in this case consists of two atoms (O-O). Phosphorous pentoxide consists of a molecule of phosphorus combined with two molecules + an atom of oxygen. When phosphorus is left to oxidise in oxygen, the molecule of phosphorus combines with two molecules of oxygen, but, this not being sufficient to form the pentoxide, it must have another atom of oxygen, which it can only get by splitting up a molecule of oxygen—one of the resulting atoms combining with the phosphorus, the other atom going to a molecule of oxygen to form ozone (O-O-O). If the ozone which has been formed is allowed to remain in contact with the phosphorus, it is decomposed thus—

$$P_2+(O\text{-}O\text{-}O)+(O\text{-}O\text{-}O)+(O\text{-}O\text{-}O) = P_2O_5+(O\text{-}O)+(O\text{-}O).$$

The powerful oxidising properties of ozone may be accounted for by supposing that the three atoms of oxygen are so loosely combined that, when it comes in contact with an oxidisable substance, one of the atoms combines with this substance, the other two going to form a molecule of oxygen.

ANALYSIS OF GREAT SALT LAKE WATER.

By H. BASSETT.

Having a small quantity of the above water placed at my disposal by Dr. W. Marcet, F.R.S., who collected it himself last August, I thought an analysis might be of interest, especially as I have not found any account of it in books of reference. The water has a slight alkaline reaction, and a specific gravity of 1·102 at 17°.

Total solid residue, in 100 parts, by weight = 13·67.

In 100 *Parts by Weight.*

Chlorine	7·36
SO_4	0·88
Sodium	3·83
Potassium	0·99
Calcium	0·06
Magnesium	0·30
	13·42

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 224).

Let us now pass on to the mode of obtaining electricity from chemical action. Before doing so a phenomenon should be noticed, which disturbs results very seriously, and which is, at present, not understood. Here is some copper wire, covered with cotton, coiled from end to end, say five or six times along this large bobbin of wood. Within the bobbin is a larger hole than usual. The two ends of this wire so coiled are connected with the reflecting galvanometer. The reflected light from this lamp is now visible and stationary upon the screen. You are aware that motion of that reflected speck of light will be the consequence of electricity passing through the coils of the galvanometer. Now, observe that, without either chemical or physical agency acting upon or in contact with the wire, we shall obtain a manifestation of electrical disturbance within the copper wire. Let the end of this steel magnet be introduced within the bobbin: you see that the speck of light immediately moves. Except in this manner, copper does not manifest electrical properties. Again, if the other end of the steel magnet be brought within the bobbin, you see the speck of the galvanometer moves in an opposite direction. Thus may be shown one form of electrical induction.

Now, with that phenomenon we are perplexed. This property of induction manifests itself at times and in ways of which we know nothing. For example, if a copper wire were laid upon this floor, and another copper wire were laid parallel to it on the floor below; and if any current of electricity passed through the wire on this floor, the one below would answer to it, although there was not any apparent contact or communication between them.

The laws which govern such electrical manifestations as these are very partially understood, and therefore the measurements of the results of these laws are for general use almost valueless. We must, however, for the present assume that the nature of the phenomena of electrical induction is clear.

The next stage in obtaining electricity is by means of what is called a galvanic cell. Such a cell usually consists of two different metals and one or two liquids. Whatever may be the arrangement, the electricity developed may be estimated by the intensity of chemical affinity during the process and at the time of the measurement. But the whole of this question of chemical affinity must now be assumed, and some of the affinities explained in the last lecture are probably the chemical affinities operating in this cell. A chemical action takes place upon a square inch of one plate, and it is met by an action upon a square inch of the other; therefore, on every square inch an action is produced. Between the two plates there is something (say the liquid) which causes the action; it is, in fact, the presence of this liquid which calls the chemical affinities into play.

A word must now be introduced which will often occur during the lecture, and it is one which performs an important part in the measurement of electricity of the character which men utilise, *i.e.*, resistance. Indeed, this resistance to the free passage of an electric current is now our chief business. Whilst the size of the plates in these cells is increased, the resistance to the free course of the manifested electricity is not decreased. Thus, for instance, from a square inch of one plate there is a current of electricity meeting or co-operating with that developed from a square inch of the opposite plate. Whatever may be the energy of the chemical affinity upon one square inch, it is met by the energy of the chemical affinity upon the opposite square inch of the other, and that energy has to overcome the resistance of the liquid between them. Now, then, assume that each of these plates is enlarged by the addition of another square inch. This introduces an additional quantity of liquid, and we have to overcome the resistance of this liquid, The difficulty of overcoming the resistance of the intervening liquid is such that, however much we multiply the number of square inches, we also introduce more liquid, and, by so doing, add further electrical resistance. Hence, however large may be the plates, we do not overcome the resistance more easily. That led to the contrivance of thus coupling-up in what is called "a series" in the form you see here, that which is familiar under the name of a cell-battery.

It may perhaps make clear what is a difficulty to many minds, if an attempt be made to explain how it is that an

* The Cantor Lectures, delivered before the Society of Arts.

electrical current which passes when cells are coupled-up "in series," that is, one after the other, is more intense than when they are combined as one large single cell.

Supposing these two plates, each 1 square inch in area, were the only two concerned, therefore there would be a certain resistance to be overcome. The chemical affinity of one such combination not only overcomes that resistance, but leaves a surplus of electricity, which surplus is said to run along the outside wire, and may produce what we call a telegraphic dispatch. Now, suppose that, in addition to those two plates, there are two others of the same size and material in a cell behind them. Between these second plates there is also a resistance similar to that between the first two. Those two second plates, however, also produce a surplus. Now, as that surplus passes over, it continues its way through the previous plates and wire, and the consequence is that, when once the resistance of its own cell has been overcome, the surplus electricity can pass through the other cells without any resistance, and, therefore, we are enabled to add the surplus of one cell to the surplus of the next, and so on. Hence, when combined in the form in which they are combined in this battery, we are manifestly enabled to pass along the connecting wire successive equal amounts of electricities, and these, flowing so very closely behind each other, produce an effect upon any resistance similar to that produced upon a slab of marble or of glass by the forcible driving against it of small grains of sand in a continuous stream. These grains penetrate, and, as it were, bore holes even in hardened steel; so these successive electricities are, as it were, continuous, and thereby overcome great resistances. It may, in connection with this, be remarked that, perhaps, in some such way as now described, the mighty energies of affinity may be accomplished by this clashing of millions upon millions of atoms and molecules. This may explain how and why it is that these cells thus arranged "in series" are under certain circumstances more effective than when the same amount of liquid and metallic elements operate as one cell only.

Electricity thus, or by other means at our disposal, is now to be measured. Two things are especially before us now. One to make clear how this measurement is made; the other to endeavour to make clear how the resistance of various bodies, be they wires or liquids, is also measured.

This electricity is measured in a very simple way. All the apparatus is here, but as it would take too long to show experiments in detail, perhaps you will kindly accept a statement of facts instead of a visible reproduction of them. In these cells is being produced a quantity of electricity, which is to be measured, much as sugar is measured by the pound, or liquids by the quart. The way it is measured is either by the chemical decompositions that it can produce, or by the amount of heat it can develop, or by other means, as, for instance, its effect upon the magnet in a given time.

This seems a convenient opportunity for directing attention to a galvanometer, which is arranged upon a plan by which is shown the amount of decomposition effected by the current indicated by the place of a needle on the dial. The gentleman who designed it had in view only a manufacturer's requirements. The measurement effected by such a galvanometer is not of that character with which this lecture is to be concerned, and therefore further reference to this particular one is not requisite.

To consider a mode of measurement we must recur to those elements—mass, space, and time. The apparatus on which my hand now rests consists of a wooden ring, about 10 inches in diameter, having coils of copper wire round it. Within this circular box with a glass top is a small magnetised steel needle. Now, the small steel needle assumes a certain position in consequence of the influence of terrestrial magnetism. Such an influence as this is not unlike a stream of water in a brook upon a short stick, one end of which is tied to a stake by a string. So long as the stream flows steadily past the stick it is retained in the same position. Let a disturbance take place in the evenly flowing water, and the stick will no longer retain either steadiness or direction. Suppose, now, that this needle is retained in a certain direction by the influence of what we may call the stream of terrestrial electricity flowing through the atmosphere of this room. (That such a stream is so flowing through the atmosphere shall be made apparent presently.) From these four cells of a galvanic battery a current of electricity may be caused to pass along the wire which surrounds this wooden ring. The arrangements are made, and such a current is now passing. What is the consequence? The even flow of that which retained the needle is disturbed, and the needle answers as the stick in the water would have done to the disturbing causes. Clearly the nature and extent of the invisible disturbance may be estimated—indeed measured—by the motions of the visible needle, just as a new position assumed by the stick would measure the disturbing influence on the stream.

The promise to let you have proof that there are currents of electricity passing through the atmosphere of this room may now be redeemed. Here is a circular wooden ring, with wire round it as before. You may notice that it can be turned as a looking-glass in its frame. The ends of the wire coiled round it are now connected with the wires of the galvanometer, the mirror of which reflects that speck of light on the screen. The looking-glass mounted ring is placed in reference to the (so-called) current of electricity always passing through the atmosphere, that were there a glass in the frame the current would beat upon that glass. If the frame be turned one-fourth round, then the current will pass parallel to the face of the frame. Or thus:—If the frame of the wire-enclosed ring be placed parallel to the direction of this magnetised needle, then the current of electricity through the atmosphere of this room is passing parallel to the ring. To move it, therefore, from this position to one at right angles to it, it is clear that the circumferential wire must, as it were, cut the stream of electricity, if there be one. Now, so cutting it, there will be a disturbance in the electrical condition of the wire, which may be manifested by a motion of that speck of light. Observe now, that every motion of the frame causes a motion in the needle of that galvanometer, which is placed on a stand far removed from the table on which the motion of the frame takes place.

The two experiments now made may satisfy you:—(1). That there is what, for want of another name, we may call a current of electricity passing through the air; (2) that disturbance of the uniform quiet flow of this current may be caused; (3) that this needle is sensitive to such a disturbance; and (4) you will perhaps accept my word for that which time alone prevents being illustrated, viz., that the amount of this disturbance may be measured by the needle—that is to say, the greater the disturbance the further will the needle be moved from its original position.

It will be obvious to all that the amount of motion in the needle for any given disturbance will depend upon its sensitiveness. Hence, two needles may or may not move equally from the same cause. A mode of measurement, therefore, which depends upon an artisan's capability to make either unit jars or needles equally sensitive cannot be one to be much relied upon. There is, however, a relationship between the motion of the needle and a totally different mode of absolute measurement of the quantity of electricity that may pass in a unit of time, which solves the difficulty now expressed.

The usual apparatus for the decomposition of water by an electrical current is standing here. It is in consequence of completing the wire circuit from this combination of four cells that decomposition takes place. The bubbles are rising regularly and rapidly. Patient

and watchful experimenters have established this, viz., the amount of water thus separated into its constituent elements of oxygen and hydrogen is always in exact proportion to the quantity of electricity that passes. If, then, it were convenient to be thus always decomposing water, a measure might be had. Thanks, however, to the mathematician, we have a much more simple mode of gaining this knowledge.

Suppose one end of the wire from these four cells is connected with the decomposing apparatus—this apparatus connected to the ring already explained—then from the ring to the other end wire of the cells. With such an arrangement observations can be made both on the decomposing apparatus and the deflections of the needle, when each is under the influence of the same current. If the quantity of electricity in the circuit varies, the amount of gas produced and the position of the needle vary also. These have been so frequently observed, that by looking at the needle the mathematician could always tell the amount of gas obtained; in fact, he could lay down a very simple rule for guidance. The application of this rule enables a person at all times to state what quantity of electricity is passing, even though he look to the needle only.

An arithmetical illustration may make this clear. Suppose that in one minute these gases, which may be seen coursing up the tube, filled a space in the tube marked 10 cubic inches—observe where the needle pointed. Let us assume that it is pointing to 45°. Suppose on another and future occasion the needle is observed to point to 60°, now, either from memory or from tables, we find that the tangent of 60° is entered as 1·73. Then, if ten be multiplied by 1·73, the result would be that 17·3 cubic inches of gases might be evolved. As there are in chemistry laws connecting the composition of bodies, such a result as this would enable a manufacturer to know how much silver, for example, this current of electricity would cause to be deposited in any fixed space of time. Thus may be measured the *quantity* of electricity passing in a unit of time.

But the deposition of gold and silver or other metals is not the only utilisation of electricity, and as other results of a very different kind are obtained from this "imponderable," it is time to turn to illustrations of another form.

(To be continued.)

CORRESPONDENCE.

PUBLIC ANALYSTS.

To the Editor of the Chemical News.

SIR,—Your able article on "Public Analysts" in the CHEMICAL NEWS of last week expresses the feelings and opinion of many aggrieved chemists.

It is mortifying to perceive persons of no more knowledge of chemistry than is acquired in the usual course of hospital instruction step into those appointments intended by the legislature and the nation to be filled by men whose training and education have fitted them for the profession of analytical chemist. It is not possible that a medical man, who, previous to his election to the post of analyst by a body of small grocers and dairymen, has perhaps never performed a quantitative analysis in his life, can, after three months study even in a *special* laboratory, have obtained sufficient experience in analysis to fit him for the responsible position he is elected to.

One might explain the fact of the analyses now performed by these gentlemen not showing many cases of serious error on the hypothesis that, when a mistake through want of skill or manipulation is imminent, the statement of analysis is so arranged as to screen the analyst himself from any possible imputation.

But really, Sir, the number of analyses that have been performed by these *medical analysts* since the Act came into force are so few and far between, that the blunders committed must necessarily be likewise small and few in number.

Altogether, the Adulteration Act does not seem to be carried out in the spirit it demands. In many places there are no analysts at all, and the electing bodies do not even intend that there should be any. In Lancashire there are, I believe, only four appointments filled, viz., those of Liverpool, Manchester, Salford, and Bolton, while all the numerous other towns and thickly populated districts are entirely without analytical supervision. It is a pity that such a good movement should be so imperfectly followed up.—I am, &c.,

RIA.

Nov. 2, 1873.

PUBLIC ANALYSTS FOR STAFFORDSHIRE.

To the Editor of the Chemical News.

SIR,—Under the head of "Miscellaneous," in your impression of last week, it is stated that Mr. W. L. Scott has been appointed Analyst under the Adulteration Act for Derbyshire and Staffordshire. This requires slight correction in case of the latter county; for, although Mr. Scott is Public Analyst for North Staffordshire, I hold the appointment for the Southern Division, as well as for this borough.—I am, &c.,

E. W. T. JONES.

Borough Analyst's Laboratory,
10, Victoria Street, Wolverhampton.
November 1, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, September 29, 1873.

Action of Gases in Coagulation of Albumen.—MM. Mathieu and Urbain.—When the gases dissolved in serum of blood are completely extracted, there is obtained an albuminous liquid which does not coagulate even at a temperature of 100°. This experiment, performed with egg albumen, formed the starting-point of the present research. The mercury pneumatic machine extracts not only the gases from albumen, but the volatile salts. The two cases are considered separately. The authors show—(1) That carbonic acid is the agent of coagulation of albumen by heat; and (2) that albumen, deprived of its volatile salts, is transformed into globulin.

New Treatment of Cholera, and probably of Yellow Fever, by Phenic Acid and Phenate of Ammonia Subcutaneously Injected.—M. Declat.

Extent of Variations of the Solar Diameter.—M. Respighi.—In this preliminary note the author replies to P. Secchi's assertion of his instrument being faulty on account of the weak dispersion of the prisms, causing undulations and oscillations, more or less marked, at the edge of the spectral image of the sun: whereas in P. Secchi's instrument, with highly dispersive prisms, the edge is still and distinct.

Action of the Respiratory Apparatus after opening of the Thoracic Wall.—MM. Carlet and Strauss.—The

authors experimented on a man having a fistulous opening into his pleura. They find—(1) That the lung of the injured side follows, to a certain extent, the movements of the thoracic cage, expanding during inspiration, and contracting during expiration, thus behaving similarly to the sound lung. (2) During closure of the thoracic opening there is intensification of the preceding phenomena; hence, after the operation for empyema, the wound should be kept closed as hermetically as possible by means of an apparatus of caoutchouc. (3) The repeated efforts after the operation form a sort of pulmonary gymnastics, which the physician should utilise.

Researches Relative to the Action of Heat on Carbonaceous Virus.—M. Davaine.

Influence of Sulphates in Production of Goitre, apropos of an Epidemic of Goitre observed in the Barracks at St. Etienne.—M. Bergeret.—The author holds the theory just indicated; but in the case of these barracks, in which there are at present some 250 goitrous soldiers, the cause (sulphate of copper) is not traceable to the water, which is extremely pure, and gives no precipitate with salts of baryta or of silver or with ammonia: photographers use it in place of distilled water. The explanation given is as follows:—For an adult to be in perfect health the anatomical tissues and organs must receive assimilable principles in equal weight with those which they incessantly destroy to maintain animal heat, and produce the mechanical work required of them. If the receipt is not equal to the expenditure there is consumption anæmia. Something of this kind occurs in the goitrous soldiers of the barracks; they have excessive work, and have not a diet proportioned to the force expended. Again, it is known that when a muscle is exerted continuously, or when it is subjected to a continuous electric current it becomes acid (consuming its own substance) the acids produced being sulphuric and phosphoric, at the expense of the sulphur and phosphorus contained in the albumenoid matters. Under such conditions a man has in circulation in his blood an abnormal quantity of sulphates, exactly as if he drank water containing these substances. From an analysis of the urine of the goitrous soldiers at different stages of the disease, M. Bergeret finds that the maximum quantities of sulphates is during the full progress of it; it is three or four times that in the normal state. The urine at the commencement ranks next, and then that of the convalescent stage.

Remarks by Baron Larrey on the Communication Relating to Acute Thyreöiditis, called Epidemic Göitre, among Young Soldiers.—The Baron has frequently found young soldiers suffer from an enlargement of the thyroid gland and neighbouring tissues owing to pressure of the shirt button, coat collar, and clasp of the chapote; a purely mechanical cause. On replacing the collar with a cravat the glandular swelling disappeared. He is unwilling to accept the term *epidemic goitre* for an affection at once simple and easily remedied, and which he calls thyreöiditis; and he suggests the possibility of the mechanical cause acting in the St. Etienne case.

October 6, 1873.

Notice of a New Derivative of Propyl. (Continuation.)—M. A. Cahours.—The author has prepared and examined oxalo-propylic ether, $C_{16}H_4O_8$. It boils between 209° and 211°. If alcoholic ammonia is allowed to act upon it a crystalline substance is obtained of the formula $C_4H_2NO_5C_6H_7O$. Carbonate of propyl, a colourless limpid liquid, boils between 156° and 160°. Its composition is $C_{14}H_{14}O_6$. Salicylate of propyl, $C_{20}H_{12}O_6$, boils between 238° and 240°. It is sparingly soluble in water, and has a hot aromatic taste. With chlorine and bromine it gives rise to crystalline products of substitution. Phenate of propyl, $C_{18}H_{12}O_2$, is a colourless mobile liquid of a pleasant odour, boiling between 190° and 191°. It is energetically attacked by bromine and nitric acid, and yields with sulphuric acid a copulated acid. Nitrite of propyl, $C_6H_7NO_4$, boils between 43° and 46°. It is a homologue of nitrous ether, and isomeric with nitropropane.

Elastic Yellow Tissue, and on Proximate Organic Analysis.—M. Chevreul.—The author maintains that Bichat first recognised the yellow elastic coating of the arteries as a distinct tissue, and insists on the importance of seeking out the proximate principles contained in living beings.

Sanitation of Marsh Lands by Means of Eucalyptus Globules.—M. Gimbert.—The author maintains that this tree, a native of Australia, has the power when planted in marshy lands of improving their sanitary conditions, as has been proved in Algeria and Cuba. It drains the swamps, and at the same time gives off antiseptic vapours.

Condensation of Gases and Liquids by Wood Charcoal; Thermic Phenomena Arising on Contact of the Liquids, and the Charcoal Liquefaction of the Condensed Gases.—M. Melsens.—This paper has been already noticed.

Production of Certain Crystalline Borates in the Dry Way.—M. A. Ditte.—The author makes use of a mixture of equal equivalents of alkaline chlorides in which he introduces the amorphous borates or the elements of the salts which he wishes to obtain. The bottom of the crucible being heated to redness a part of the borate dissolves in the fused mass, and crystallises in the upper and cooler portions. In this manner the borates of lime BoO_3CaO; $3CaO,2BoO_3$; and $2CaO,3BoO_3$; and the borates of strontia, $SrO,2BoO_3$; $2SrO,3BoO_3$; SrO,BoO_3; and $3SrO,2B.O_3$.

Researches on Tribromacetic Acid.—M. H. Gal.—This acid consists of—

Carbon	8·70
Hydrogen	0·33
Bromine	87·50
Oxygen	3·47
	100·00

It is easily etherised. In presence of alkalies and under the action of heat it is decomposed, giving rise to bromoform and the carbonate of the base employed. This acid is very energetic, its salts crystallise readily; that of baryta forming long needles, and that of copper bulky prisms, apparently isomorphous with the acetate.

Claim to Priority as regards the Action of Ammoniacal Gas on the Nitrate of Ammonia.—Dr. E. Divers.—With reference to the memoir of M. F. M. Raoult on this subject (*Comptes Rendus*, May 12, 1873). Dr. E. Divers shows that his paper on the same reaction was presented to the Royal Society October 29, 1872, read January 9, 1873, and published in its *Proceedings*.

Note on Means for Maintaining in a Given Place a Temperature Nearly Constant, and for Moderating in Summer the Temperature of Dwelling Houses.—Gen. Morin.—The principle of the author's method is to renew the air regularly through the introduction by moderated aspiration of fresh air at constant temperature. It is known that at a depth of about 24 metres the internal temperature of the ground is constant. A supply of air is drawn from pits at this depth, or a less depth may suffice. The general dispositions are as follows:—The principal room, in which the temperature is to be kept constant, is preceded by another of nearly the same capacity (or only a small antechamber), which acts as a sort of dam for the entering air. This room should have walls, ceiling, and floor pretty thick. The floor and walls rest upon vaults; the walls are surrounded at a short distance by an isolating *enciente* of the same form, communicating with the vaults and the bottom of the aëration pits. Orifices made near the top of the ceiling of the room and that of the *enceinte* are in direct but distinct communication with draw tubes (*tuyaux d'appel*) in which are burners kept lighted under

constant pressure; their number varied according to the season. The air to be introduced into the principal room, into the subterranean vaults, and into the envelope, is taken from near the bottom of the pits by a special pipe of suitable size. The added building may be in a street, and may be lighted by double windows on the north side: the interval in the windows being in free communication witn the isolating envelope. The author shows, from Newton's law, that the volume of air to be introduced is greater the nearer the temperature to be maintained inside approaches that of the air introduced, and the more extensive the cooling surface (it would become infinite if the interior temperature were equal to that of the introduced air). Further, that, other things equal, this volume will be proportional to the value it is judged convenient to assign to the fraction—

$$\frac{T - T'}{T' - t}$$

where T is the temperature external to the added building or its envelope, T' the internal temperature, and t the temperature of air to be introduced into it. The question is simplified wherever the fraction is supposed = 1. (Some numerical examples are given.) In places where instruments of precision are kept the temperature should be a little above that of the air introduced; otherwise the entering air in cooling deposits on the walls and apparatus a portion of its vapour. The foregoing arrangement is valuable for various applications, as places of meeting, places for keeping food, &c.

Report on Memoir by M. Mannheim on the Trajectory Surface at the Points of a Figure of Invariable Form, the Displacement of which is Subject to Four Conditions.

Studies on Phylloxera.—M. Max Cornu.—The author asserts the identity of the insect attacking the roots with that attacking the leaves, but it seems less attracted to the leaves.

Effects of Sulphide of Carbon used to Destroy Phylloxera on the Vine Itself.—M. Lecoq de Boisbaudran.—The leaves of vines thus treated have withered, though remaining attached to the branches. The remedy seems effective against phylloxera but, besides injuring the vines, is too expensive to be used.

Size and Variations of the Sun's Diameter.—(Second note by M. Respighi.)—P. Secchi has stated that the duration of passage of the solar diameter, measured by mono-chromatic images obtained in the spectroscopic telescope with the direct-vision prism before the slit, was less than the duration given in the Greenwich Nautical Almanack by about 0·6 s., whence he infers that the diameter of the mono-chromatic image of the sun is about 8 seconds less than the diameter of the image with compound light, obtained by the simple telescope with coloured glass. M. Respighi is unwilling to admit this difference. He suggests possible causes of error; imperfect rectification and instability of instrument, influence of atmospheric refraction, but more especially the influence of variations of temperature of the prism. These sensibly displace the spectral lines. The results are constant P. Secchi says; but it is replied, that during each passage of the solar image the temperature of the prism could not continue constant, and its variations would be reproduced periodically in successive passages (independently of the absolute temperature). It is precisely these periodic variations which might displace the solar image by a quantity nearly constant in all the successive passages. (This influence is much less sensible in the author's own instrument, in which the aperture is reduced by a diaphragm, and the prism has little absorption.) Other possible causes of error are the undulation or agitation of the sun's border, and the personal error in observation of the two contacts. Some of the causes mentioned are avoided by using the objective prism. The author's observations by both methods gave results differing very little from those in the Nautical Almanack (not more than + or −0·12 sec.)

Theory of Earth Pressure.—M. Curie.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxii., No. 6, October 9, 1873.

Absorption of Gases by Charcoal, and their Spontaneous Liquefaction.—M. Melsens.—This chemist has obtained wood charcoal absolutely pure, and possessed of such high absorptive power that it can concentrate in its pores its own weight of gas. When charcoal thus saturated with any of the more readily liquefiable gases, such as cyanogen or chlorine, is placed in a glass tube fitted with a neck bent at right angles and closed at one end, and heated to 100° by a current of steam, the gas escapes, and compressing itself in the closed end of the tube passes at once to the liquid state.

New Generator of Electricity.—M. Clamond has constructed a new thermo-electric apparatus, which is ready to give a powerful and constant current whenever the furnace is lighted, and from which important industrial results are expected.

No. 7, October 16, 1873.

Cultivation by Means of Dynamite.—It is proposed, instead of ploughing or digging the ground, to bore holes, fill them with dynamite, and explode them!

No. 8, October 23, 1873.

This number contains no original chemical matter.

No. 9, October 30, 1873.

International Patent Law.—The Congress of Vienna has unanimously passed resolutions in favour of this desirable reform.

Phosphatss of Quercy, of Lot, &c.—These phosphates appear to furnish phosphoric acid to the soil if spread on the land in their natural state, without any other treatment except grinding to powder. They appear to contain a proportion of bibasic phosphate, which accounts for their solubility and efficacy.

Method of Determining Sugar by Means of a Salt of Iron.—M. E. Riffard.—Perchloride of iron solution, prepared by dissolving in pure water the crystalline perchloride of iron, requires to 100 milligrms. of iron 2·587 grms. of sugar to remain unprecipitated in presence of ammonia. 25·87 grms. of the sugar to be tested are dissolved, a few drops of oxalate of ammonia added to throw down any lime, filtered, and the solution made up to 250 c.c. Of this 25 c.c. are taken, and according to the number n of hundredths of pure sugar contained in the sample n hundredths of iron may be added, and will remain dissolved. In two determinations different results are obtained, viz., with n milligrms. of iron, a limpid solution; with $n+1$, a precipitate; n being the percentage of sugar in the sample. With sugars of unknown origin the sample is previously shaken up in the cold with alcohol at 95 per cent, and filtered to remove inverted sugar, which has a stronger action on iron than crystallisable sugar. The author states that the results obtained by this method agree with those furnished by the saccharimeter.

Treatment of Resin Oils.—When heat is applied to the retorts a light oil, crude pinoline, passes over at first, and then ceases. The receivers are changed, and the fire augmented, when the heavy oils pass over, and colophonium is left in the retorts. The heavy oils are of a deep violet colour. They are boiled for a day with water, and a part of the matter which passes off with the steam is collected. The next day the water is drawn off, and the residue saponified with caustic soda at 36° B. The almost solid product is then heated anew till no more oil distils over. The oil which has been distilled (single rectified) is submitted again to the same treatment, and that which finally passes into the receiver is called double

rectified. It is used for adulterating fish oils. Crude pinoline contains acetic acid, from which acetate of lime may be prepared by neutralising the crude product of distillation with chalk, and re-distilling the oily liquid.

Use of Slags.—At Osnabruck slags are granulated by being allowed to flow at high temperatures into water. Thus divided it can be used as ballast for railways. If much alumina is present the slags can be used in the manufacture of alum.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Mène, No. 35, 1873.

Manufacture of Iodide of Potassium from the Mother-Liquors of Kelp or Crude Soda.—This process consists in transforming into iodates the alkaline iodides contained in kelp lyes; then in precipitating the iodic acid with a soluble salt of baryta, heating the precipitate with a solution of sulphate of potassa, which yields a solution of iodide of potassium, evaporating this to dryness, and finally fusing the residue, and allowing the solution of the iodide of potassium thus obtained to crystallise. The conversion of the iodides of the mother liquors into iodates may be effected by one of the methods indicated below; but it is important to precipitate entirely or in great part the sulphuric acid contained in these waters by means of chloride of barium. At the same time a little silicic acid and other impurities are eliminated, and it becomes more easy to treat the product obtained by the iodate of baryta. After having collected this precipitate the mother liquor is evaporated to dryness to destroy the organic matters present, and the residue is fused. The liquid obtained from the solution of the melted mass after being freed from insoluble matters is rendered alkaline by the addition of a caustic or carbonated alkali to such an extent that there may be 5 atoms of caustic alkali or 10 of carbonate for each atom of iodide. This addition of alkali is unnecessary if the fourth of the following methods is to be employed. (1) A current of chlorine is passed through the liquid until the iodide is transformed into iodate, but no longer. (2) A solution of an alkaline permanganate is added to the liquid until a very slight but permanent rose-coloured tint is produced. The precipitate of manganese is filtered off, and re-converted into permanganate by fusion with soda or soda and saltpetre. (3) An electric current is passed through the liquid. (4) An atom of an alkaline chromate is added for every atom of iodide present. The whole is evaporated to dryness, cautiously heated without raising the temperature to redness until the iodide is converted into iodate. After the iodic acid is removed from the mother-liquor the bromide which may remain in solution is transformed into bromate by the first or fourth method above-mentioned.

No. 36, 1873.

This number contains a notice of a machine for roasting coffee, starch, barley, &c.; the effervescing beverages manufactured by Nitot et Cie.; and of the method of rendering cloth water- and fire-proof carried out by Dujardin.

No. 37, 1873.

This number is totally free from chemical matter, whether scientific or industrial.

Revue Scientifique de la France et de l'Etranger, October 11, 1873.

M. Zinin shows that desoxybenzoin dissolved in alcohol with caustic potassa absorbs oxygen from the air, forming benzoic acid and a very complex body, benzamaron; which, on prolonged ebullition with caustic potassa, reforms desoxybenzoin and amarinic acid.

Fritsche finds that tin may be rendered crystalline and brittle by exposure to intense cold.

Boutlerow has made experiments on isobutylen to verify the hypothesis of a double series of atoms of carbon in the non-saturated carbides of hydrogen. Isobutylen yielded instead of crotonylen an isocrotylic ether.

Mendeleew has determined the calorific capacity of cerium.

Boradine has studied a monatomic alcohol containing 10 atoms of carbon obtained by the action of sodium on valeraldehyd.

Lazarenko having found that benzoyl-anilid does not yield directly nitro-derivatives has prepared them by causing nitro-benzoic aldehyd to act upon anilin, and benzoic aldehyd and nitro-benzoic anilin upon nitranilin.

Struve concludes that all combustion generates ozone, peroxide of hydrogen, and nitrate of ammonia.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the treatment of stable manure and for obtaining useful products therefrom. Arthur McDougall, of the firm of McDougall, Bros., manufacturing chemists, Manchester and London. February 13, 1873. No. 542. This invention consists in treating stable manure or litter, which has hitherto been used only as a fertilising agent, in such a manner as to render it available for use in the manufacture of paper-pulp, and consists in thoroughly washing such manure or litter with water by any suitable or well-known mechanical contrivance, with a view to the removal of the fœcal matter therefrom. The cleansed straw thus obtained may either be treated by any suitable or well-known process for the manufacture of the same into pulp for the making of paper and similar products, or it may be dried and again used as bedding for horses and cattle generally.

Improvements in electric telegraphs. Henry Highton, M.A., Putney, Surrey. February 13, 1873.—No. 545. This Provisional Specification describes special arrangements by which the gold-leaf instrument is applied advantageously to work long lines, especially where the insulation is defective.

Improvements in the manufacture of iron and steel. Jacob Geoghegan Willans, 9, Saint Stephen's Crescent, Bayswater, Middlesex. February 14, 1873.—No. 547. Ore in a divided state is employed together with materials to prevent its falling through the interstices of the fuel. Apparatus is also described for charging the furnace. Improvements on the "Uchatius" process are also described, and granulated metal is produced for the manufacture of steel and malleable castings.

An improved composition for removing and preventing incrustation in boilers. David Hutchison, Mile End, and William George Bridges, Stepney, Middlesex. February 14, 1873.—No. 551. The features of novelty of this invention consist in combining together catechu, chlorine, linseed, sodium, nitre, sulphate of potash, alum, calcium, and ammonia, in certain proportions.

Improvements in apparatus and in the materials and appliances employed for the filtration of water, sewage, and other fluids, whereby manure and other valuable products are separated, precipitated, and obtained therefrom. Francis Henry Atkins, engineer, 62, Fleet Street, London. February 14, 1873.—No. 556. One part of this invention has for its object improved arrangements of apparatus and mechanism for the filtration of water, sewage, and other fluids, being specially adapted for the separation of the grosser impurities from water for manufacturing and other purposes, or for filtering the effluent water of sewage, the polluted water from paper or other manufacturing works to prevent the pollution of rivers, or for other purposes. The invention also relates to the preparation and application of coke in solidified blocks or slabs, for the filtration of water, sewage, or other fluids. The filtering materials in the form of blocks are secured in open removable frames or slides. The frames with the filtering blocks or slabs are then placed and fixed in position across a water-course, tank, passage, or channel, through which the water, sewage, or other fluid to be filtered is arranged to flow. Part of the series of frames may contain sponge, felt, or other filtering materials. When the filtering slabs are coated with the impurities, they are removed and allowed to dry, and are cleansed by scraping, the scrapings being converted into manure. According to another of these improvements, the grosser impurities are withdrawn from water, sewage, or other fluids by means of endless bands of wire-gauze, hair-cloth, canvas, sponge, or other suitable materials mounted upon rollers, and arranged so as to revolve in a tank or passage, through which the fluid to be filtered flows. Another part of these improvements has for its object the application of galvanic, magnetic, or electrical action to filtering apparatus, reservoirs, or tanks, for the purpose of precipitating organic and inorganic matters or impurities held in suspension or solution in the water or other liquids.

Improvements in the deodorisation of excreta, and in the manufacture of manures therefrom. Major-General Henry Young Darracott Scott, C.B., Ealing, Middlesex. February 15, 1873.—No. 570. The object of this invention is the prevention of nuisance in dealing with night-soil and urinous liquids, and the fixation of their fertilising elements so as to render them valuable marketable commodities.

Improved methods for purifying gutta-percha. Thomas Cattell, M.D., Clarendon House, 25, Clarendon Square, Middlesex. Fe-

bruary 17, 1873.—No. 587. By this invention crude gutta-percha is deprived of its impurities by treating it by—Process No. 1. The solutions of gutta-percha, made according to Specification No. 446, 1859, are filtered or strained, and the gutta-percha recovered by means of alcohols, vapour of alcohols, or steam. Process No. 2. Crude gutta-percha is softened by the action of solvents, hot water, or steam, and mechanically strained, and the solvents afterwards removed and recovered by means of steam. Process No. 3. Crude gutta-percha is softened by a mixture of the usual solvents of gutta-percha with alcohols, and mechanically strained, and any solvent adhering to the gutta-percha drawn off by steam, and collected. Process No. 4. Gutta-percha, obtained by what is termed in the said Specification, No. 449, "the process of congelation," is broken up and passed into a chamber, where it meets either the vapour of alcohols or steam, and the solvents of the gutta-percha, or the alcohols used are collected.

Improvements in spicing and preparing malt or distilled vinegar, rendering the same better suited for pickling purposes. Annetta Jane Honor Hutchings, 2 and 3, Quay Head, Bristol. February 17, 1873.—No. 588. The inventor takes malt or distilled vinegar, chilis, cloves, ginger, pimento, mace, and nutmeg, all or some, and (1st) grinds and commingles together the spices, and (2nd) places the ground spice in an earthen or other vessel with perforations in the bottom, which vessel is placed in another earthen or other vessel. Both vessels are placed in a boiler, the vinegar being poured into the inner vessel upon the spices, and the contents of the boiler being kept simmering for a sufficient time, the strength of the spices is drawn out into the second vessel, and, upon being filtered, is fit for bottling.

NOTES AND QUERIES.

Distillation and Purification of Glycerin.—Can any of your readers give, or refer the enquirer to, information on the above?

Maximum and Minimum Thermometers.—Mr. H. Smith, in his "Chemistry of Sulphuric Acid Manufacture," describing his experiments on temperature, says that he used "ordinary maximum and minimum thermometers" fixed on glass; I should feel much obliged if he would give me a further description of the sort he used, and if he could say where such are to be procured.—A MANUFACTURER.

Malleable Cast-Iron.—I should be thankful if you, or any of your scientific correspondents, would, through the medium of your paper, kindly give me a little information respecting malleable iron castings. (1). Are the so-called castings malleable? (2). Is malleable cast-iron chemically different to common cast-iron, and what is the difference? (3). How is malleability produced in cast-iron? By oxidation of the carbon, or some other chemical process? By a mixture of wrought-iron, or by annealing?—RICHMOND BAKER, Cert. Teacher of Science, The Gouger Street Academy, Adelaide, S.A., Sept. 10, 1873.

Iron Wire in Claret.—A small fragment of wire having been accidentally left in a bottle of claret, communicating a most abominable taste to it, I dropped in a scrap of silver-foil and corked it up again, removing the remnant of iron wire. In a few days I tasted the wine again, and found that, though nasty, the worst part of the taste, that of hydrogen sulphide, had disappeared. Had the sulphur been present as impurity in the iron? It has struck me that perhaps small aquarium tanks might be saved if, at suspected spots where minute fixed organisms are perishing, scraps of silver-foil were placed with the tongs; at all events they would remove the H_2S evolved. May I ask if this has been tried, or if, in the opinion of chemists and naturalists, it is likely to be of use?—MARSHALL HALL.

A New Method for the Preparation of Chromic Acid.—The following method is based upon the decomposition of barium chromate by nitric acid, with the separation of the barium nitrate thus formed, by means of sulphuric acid. Precipitated barium chromate is added to boiling nitric acid (diluted with an equal bulk of water) till completely saturated; the whole is then allowed to cool, when the greater quantity of the barium nitrate crystallises out. To the mother-liquor a sufficiency of sulphuric acid is added, to precipitate the remainder of the barium; the barium sulphate settles readily to the bottom of the vessel. The supernatant liquor, containing chromic and nitric acids, is drawn off and evaporated to dryness on a water-bath, when all the nitric acid is expelled, leaving a residue of nearly pure chromic acid, which may be purified by crystallisation. By this method, nearly the theoretical quantity can be obtained from potassium chromate.—J. MCLELLAN, Shawfield Chemical Works, Glasgow.

Detection of Petroleum Spirit in Coal-Naphtha.—(Reply to E. J. D.).—First, test the specific gravity of the naphtha; should this indicate, say, 0·86 or thereabouts, there are some grounds for suspicion as to presence of petroleum spirit. Next, place about 250 c.c. of the suspected naphtha in a flask fitted with Liebig's condenser and thermometer, and distil off all coming over below 115° to 120° C. Take this portion boiling below 120° C., and place in a fresh flask, and distil again, collecting apart all coming over below 85° to 90° C. This is tested as to its odour and specific gravity, and, if petroleum spirit has been used, the former is usually sufficiently unmistakeable, but is further confirmed by an examination as to the latter, the extreme lowness of which will decide the point. Scotch naphthas have usually a somewhat lower specific gravity than English; in fact, they are frequently met with as low as 0·86. To decide if genuine, *i.e.*, free from spirit, make the above-mentioned examination in the manner described, and, if the lowest boiling portion extracted thus from the bulk possess, after the second distillation and extraction, a specific gravity not differing very materially from that of the bulk of the original naphtha, the sample may be considered genuine as regards light petroleum spirit.—WATSON SMITH, F.C.S.

Notes on the Utilisation of Sewage.—(From the "Report of the Main Drainage Committee for 1864," vol. 487).

1886. (Mr. Bowing). Mr. Hughes, in his book on waterworks, says, p. 291, that the cost of covered reservoirs varies from 30s. to £3 per thousand gallons of capacity, and that the cheapest reservoir which was built was at Wolverhampton. That reservoir contains 1,500,000 gallons, and the cost, exclusive of land, is said to have been £2200. He says that a reservoir to contain 2,000,000 gallons would cost £4162, so that it appears that a reservoir costs about £2 for every 1000 gallons.

1990. (To Mr. Ellis). With regard to quantity, is there not among agriculturists a system of high farming and the contrary?—Yes.

1991. And does not that consist, as in Mr. Mechi's case, of putting on very pure land a very large quantity of very rich manure?—You can put a large quantity of solid manure, not of liquid manure, because the liquid manure will run away.

1992. Then your remark applies that there is a limit to liquid manure, but not to solid, is that so?—If you put a larger quantity of liquid manure on the earth than the earth can deal with, it runs to loss. Professor Way's evidence proves that.

2032. (To Mr. Ellis). But if I tell you that I apply sewage to land in frosty weather, and that I have seen it a foot in thickness in ice, and that when the thaw came it melted gradually on to the land and became absorbed, would it alter your opinion?—That would be the case, no doubt; but during the continuance of the frost, it would not be absorbed. There would be nothing to prevent the farmers from applying it at all times, but I assume that they would not do so.

2033. Of course there would be no annoyance from the sewage being in a frozen state?—Of course not.

2041. (To Mr. Ellis). Have you made any calculation of the height?—Yes, if we had to lift the sewage on the north side to 460 feet, that would cost us 0·267,121d., or ¼d. 0·017,121 for each ton, or a little over a farthing a ton.

2042. Does that include the cost of the sewage as well as the cost of the carriage?—That would be the cost of pumping only, and lifting it to a height of 460 feet; and that, I believe, is excessive.

2051. (To the same). The evidence of Professor Way proves that there is a limit to the power of the earth to receive manure, and that that limit is very soon reached; therefore, when you put sewage in the great quantity that Mr. Lawes does upon the earth, you must run it away to loss because the earth cannot deal with it.

2052. What amount of sewage per acre per annum did he apply?—On one part of the land 3000 tons, on another part 6000 tons, and on another part 9000 tons per acre.

2053. Do you know what amount Mr. Mechi applies to land with advantage?—I think it is very small; it is 45 tons, or something of that kind.

2089. (To Mr. Ellis). Would you be astonished to hear that a large proprietor has erected works, at very great cost, to be used in a certain district, and that all he required was that the occupiers of the ground should pay for the pumping?—I should be astonished if no explanation were offered.

2090. Those works were erected by the Duke of Northumberland, and then the inhabitants and occupiers of the land in the district refused to pay for the pumping.

2151. (To Mr. West). Have you a detailed estimate there in your hand?—Yes; 200 feet may be pumped at one lift, or you may divide the 300 feet or 400 feet into two lifts. Cornish pumping-engines, including boilers, erected complete, but exclusive of pumps and buildings, will cost £35 per actual horse-power. I cannot estimate the cost of buildings, not knowing the cost of foundations, &c. When in duplicate they will cost £30 per actual horse-power. For all heights less than 30 feet, the single-acting drawing-pump would be used, and above this height the plunger forcing-pump. The valves should be on the principle of Harvey and West's double beat valves. The cost of lifting 1000 tons 50 feet high will be 2s. 4d., and for every 50 feet 2s. 4d. must be added; therefore to lift this quantity 100 feet will cost 4s. 8d., 200 feet, 9s. 4d.; 300 feet, 14s.; and 500 feet, 23s. 4d. The above includes coal, labour, oil, tallow, and hemp. The cost of lifting one ton is very little; 4½ tons can be lifted 500 feet high for one penny. I would recommend a brass sieve, made in the form of a basket, to be placed at the bottom of the well, through which all the fluid should pass before arriving at the entrance of the suction-pipe; the sieve to be so mechanically arranged for hauling to the surface for clearing.

Now Ready, Price 5s.,

Milk-Analysis.—A Practical Treatise on the Examination of Milk (including Cream, Butter, and Cheese). By J. ALFRED WANKLYN, M.R.C.S., Corresponding Member of the Royal Bavarian Academy of Sciences, Public Analyst for Bucks.

London: TRUBNER and CO., Ludgate Hill.

Analysis of Food, Water, and Air.—Mr. WANKLYN has opened a Laboratory at 117, Charlotte Street, Fitzroy Square, and is prepared to give Practical Instruction in Chemical Analysis to Medical Officers of Health, and to persons proposing to undertake the duties of Public Analysts under the new Act

Two Courses of Lectures on Geological MINERALOGY will be given at KING'S COLLEGE, LONDON, by Professor TENNANT, to which the public are admitted on paying the College fees. One Course is given on Wednesday and Friday mornings, from 9 to 10 o'clock, commencing Wednesday, October 8th, and terminating at Easter, 1874. The other Course is given on Thursday evenings, from 8 to 9, commencing October 9th. The Lectures are illustrated by a very extensive collection of specimens.

Practical Instruction in Mineralogy and Geology is given by Prof. TENNANT, F.G.S., at his residence, 149, Strand, W.C.

THE CHEMICAL NEWS.

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MEMORANDUM ON THE PURIFICATION OF DRINKING-WATER,

WITH SPECIAL REFERENCE TO THAT WHICH IS LIKELY TO BE MET WITH ON THE GOLD COAST.

By WILLIAM CROOKES, F.R.S., &c.

The following memorandum has been drawn up at the request of Sir William Muir, of the Army Medical Department :—

In the absence of any specific information as to the quality of water likely to be found on the Gold Coast, the following remarks are necessarily somewhat general in character.

Disinfection of water cannot be effected by one substance which removes all the evils at once. There are likely to be many septic bodies in various conditions, and each has to be attacked in a special way.

The danger certainly lies in the organic matter present in the water; but it bears no constant relation to the quantity present. Water may contain a large quantity of peaty organic matter—as much as 4 or 5 grains to the gallon—and be harmless : whilst a very small fraction of this quantity of another kind of organic matter may make it a deadly poison.

Malaria appears to be caused by the decomposition of organised bodies. Soils generally are acid, and the drainage-waters from them are comparatively harmless. But, under conditions which are frequently likely to obtain in a tropical country,—such as great heat, low lying position, damp marshy soil, exuberant and dense vegetation preventing excess of solar rays to the soil—the soil is likely to become more alkaline than the vegetation will bear; putrefactive decomposition will commence, the oxygen in solution in water will be insufficient to restore the balance, and malaria will be the result. In the drainage water from such a tract of country the germs of fatal diseases are almost certain to be present,—to what extent we are ignorant.

That the poison is in the water rather than in the air is well illustrated by a circumstance related by Dr. Woods (Chemical News, vi., 307). Two ships were dispatched simultaneously with troops from Algeria to France, both under similar circumstances, excepting that the supply of water had been drawn in one case from the low marshy lands where ague was prevalent, whilst the other ship had taken water from a locality situate at a greater elevation, and where the disease was unknown. The passengers on board the first transport were quickly seized with remittent fever, whereas no case of illness occurred on board the second vessel.

The means relied upon for destroying or neutralising the poison in bad water are, with the general public, addition of permanganate of potash, and filtration through charcoal.

For general purposes these may be sufficient, but in cases of real difficulty they are likely to be most unsafe, if not positively harmful as leading to a fancied security.

Permanganate of potash exerts extraordinary destructive powers on some kinds of organic matter. Thus the offensive gases of putrefaction are at once deodorised, and many kinds of organic matters, such as oxalic acid, sugar, &c., are almost instantly destroyed. With other substances, however, such as the scent of musk, urea (from urine), the strong smelling valerianic acid, lactic acid (from sour milk), and butyric acid (from rancid butter), permanganate of potash has little action, and it has not much effect on strychnine, and some other violent poisons.

If we divide the organic matter in water into three classes, viz. :—

(1). Matter already in a state of putrefaction,
(2). Matter ready to become putrid,
(3). Matter which is slow to decompose,

it will be found, *practically*, that the matter in class 1 will be the only organic matter which permanganate of potash will remove. It will destroy this at once, whereas to destroy organic matter of the second class with permanganate of potash will require from fifteen minutes to an hour; and to destroy matter of the third class will require from some hours to some days. Moreover, living matter has considerable resistance to the oxidising power of permanganate of potash; microscopic animalcules will live for upwards of an hour in water tinted with it, and living beings, visible to the naked eye, will live in a much stronger solution.

If a soldier, provided with permanganate of potash, after mixing a little with water waits only a few minutes before drinking it, he will certainly imbibe most of the organic matter of classes 2 and 3; whilst he would have to defer quenching his thirst for about half an hour before the matter of the second class would be destroyed, and for at least a day before matter of the third class would be attacked; and even then he would be by no means safe.

Practically, however, if the soldier used the permanganate at all, he would not be likely to do more than wait for a few minutes.

But the probability is so great as almost to amount to a certainty that the septic matter of the water would reside in the organic matter of classes 2 and 3.

The specific disease-producing particles are doubtless organised germinal matter, or cells, possessing physiological individuality, capable of preserving their activity for a certain time when out of the water in the form of slime, or even dust, able to adhere to material objects, and to be carried from one place to another on the clothing or in currents of air.

To remove these bodies from water, permanganate would be inoperative within the time in which it would be allowed to act. Filtration through charcoal would at first sight appear to be a satisfactory safeguard; but it is not sufficient, for many reasons.

In the first place charcoal acts mechanically as a filter, and should therefore remove solid germs. But these cells are supposed to be so extremely small that it is doubtful whether they would be kept back by merely passing water rapidly through an ordinary filter, whilst if they were kept back they would accumulate only with their tremendous power for evil uninjured, on the upper side of the filter, ready at the first accident to act as the focus of a pestilence.

In the second place a charcoal filter acts as an oxidising purifier for the water which passes through it. The oxygen condensed in its pores destroys organic matter somewhat as permanganate of potash does. To keep charcoal efficacious, however, as an oxidiser, it should be allowed to get dry nearly every day, and should be frequently cleaned. Even at its best it is not likely that it will oxidise organic matter more readily than will permanganate of potash, and hence matters of the second and third class—probably the most dangerous of all—are likely to pass through.

There is another purifying agent which has stood the test of long experience, and which possesses properties which are especially valuable in the present case. I allude to sulphate of alumina. When this salt is added to water containing organic matter of different classes, it passes by that which is so easily oxidised by permanganate of potash, but it attaches itself to organised animal matter—living germs—and converts them into an insoluble substance like leather. It is not quite certain whether this tanning operation destroys

vitality: probably it does; but at all events the precipitate is capable of being filtered with the greatest ease, whilst the addition of sulphate of alumina in no way interferes with the use of the permanganate of potash. If fine clay be used along with the sulphate of alumina the precipitation takes place with great rapidity, and filtration need not be resorted to, but the clear water can be poured off the sediment in the course of a quarter of an hour.

Under the name of A B C compound a mixture of sulphate of alumina, clay, and charcoal has been successfully used by the Native Guano Company for the purification of sewage. At their works I have repeatedly seen the sewage of such places as London, Paris, Hastings, and Leeds, converted in the course of a quarter of an hour from an offensive looking, vile smelling liquid, into water, bright, clear, inodorous, and tasteless, non-putrescible, and so free from injurious matter as to allow delicate fish to live and thrive in it.

With a little necessary modification I consider that a mixture capable of acting thus on town sewage is the most suitable for the purification of water for drinking purposes on the Gold Coast.

I would suggest that the charcoal be omitted, and its place supplied by a permanganate. The ordinary potash salt will do, but if procurable in time I have reasons for believing that permanganate of lime would answer the purpose better.

I have prepared a mixture of—

1 part of permanganate of lime,
10 parts sulphate of alumina,
30 parts fine clay,

and find that when I add this to London sewage in the proportion of 20 to 10,000, the purification is very satisfactory, and the settlement rapid. With foul ditch water a less quantity will do.

The mixture can be filtered, instantly yielding a bright filtrate, or it can be allowed to settle for a quarter of an hour, when the supernatant water can be poured off equally bright.

I am not prepared to say what the price of this mixture would be, but it would probably not be many pence per hundred gallons of water.

PRELIMINARY INVESTIGATION OF THE FLUORESCENT AND ABSORPTIVE SPECTRA OF THE URANIUM SALTS.*

By HENRY MORTON, Ph.D.,
and H. CARRINGTON BOLTON Ph.D,

(Continued from p. 234).

Uranic Oxyfluorides.

The chemical relations of these salts have been made the subject of a special investigation by one of us, and will be found fully discussed,† but the following brief notes may be useful in this place:—

Uranic oxyfluoride is obtained by dissolving the sesquioxide of uranium in hydrofluoric acid. If the three-fourths oxide be treated with this acid, uranous fluoride also orms as an insoluble green powder, which may be separated by filtration.

Potassio-uranic oxyfluoride, $2(U_2O_2Fl)+3KH$, is best prepared by adding potassio-fluoride to a solution of uranic nitrate, dissolving the lemon-yellow crystalline precipitate in warm water, and crystallising. The corresponding sodium salt, being very soluble, can be prepared in this manner; it is obtained with difficulty by evaporating a mixture of uranic nitrate and sodic fluoride in a desiccator. It has the constitution $2(U_2O_2Fl)+NaFl+8HO$. The barium compound forms a crystalline precipitate; the ammonium salt is obtained only as a deliquescent mass.

The following salts have been examined:—

$(U_2O_2)Fl$
$2(U_2O_2)Fl+NH_4Fl+xHO$
$4(U_2O_2)Fl+3Ba\,Fl+4HO$
$2(U_2O_2)Fl+3K\,Fl$
$2(U_2O_2)Fl+Na\,Fl+4HO$
$2(U_2O_2)Fl+Na\,Fl+8HO$

These all fluoresce with various degrees of brightness, and yield very remarkable spectra, having, in the case of two of the double salts especially, a strong similarity to the double oxychlorides in complexity of structure. Their absorption spectra are also marked.

Uranic Oxyfluoride, $(U_2O_2)Fl$.—This salt gives a spectrum which, in the general character of its bands, much resembles the acetate, normal sulphate, &c., or what may be called the normal type. There are, however, in it slight indications of inflections of brightness in the individual bands, which we find strongly developed in the double salts, These indications are, however, too delicate to be correctly represented in the cut, being, in fact, only recognisable when specially looked for. This spectrum is shown at 2 of Fig. 12. The absorption spectrum of this substance is likewise well marked, and is shown in 2 of Fig. 13. When dissolved in water, and acidulated with hydrofluoric acid, this yields an absorption spectrum such as is shown at 3 of Fig. 13. In this the general absorption is strong, and the bands are relatively faint. If no acid is added to the solution of the uranic oxyfluoride, we obtain a spectrum of absorption similar to the above, but with the bands all displaced a little upwards; thus—

Absorption-Bands of Uranic Oxyfluoride in Solution.

Bands.	1.	2.	3.	4.	5.	6.
With acid ..	93·0	103·0	114·0	124·0	136·8	—
Without acid..	95·2	105·0	115·4	125·0	137·6	150·0

The Double Oxyfluorides.

Of these the most brilliantly fluorescent is the potassium salt, and we will therefore describe it in detail, and the others by reference to it. This salt fluoresces pretty strongly, and yields a spectrum in which each band is composite, the stronger or brighter ones showing three elementary stripes, which are recognisable, but by no means so decidedly marked as those of the double oxychlorides. In Fig. 12, No. 1 will give some idea of this spectrum.

The other double fluorides of this class yield similar spectra, the positions of whose brightest parts are given below. The barium salt shows the same structure in its bands as the potassium one, but the others exhibit only single blended bands. The following table will give the positions of the brightest line in each group in the various spectra, these being named in their order of brightness:—

Fluorescent Spectra of the Double Oxyfluorides.

Bands.	1.	2.	3.	4.	5.	6.	7.	8.
Potassio..	32·4	39·2	46·8	54·7	63·7	73·9	83·4	89·8
Bario ..	32·0	38·4	46·4	54·2	62·8	72·0	81·4	89·2
Ammonio	32·0	38·4	46·4	54·2	63·3	72·9	82·7	91·3
Sodio ..	30·4	38·8	47·6	57·2	66·1	76·0	86·4	—

The absorption spectrum of the potassio oxyfluoride is shown at 1 of Fig. 13.

Uranous Fluorides.

The salts of this class examined, were those first studied by one of us, and described fully in *Zeitschr. f. Chem.*, [2], ii., 353, and *Bul. Soc. Chim.*, 1866, ii., 450.

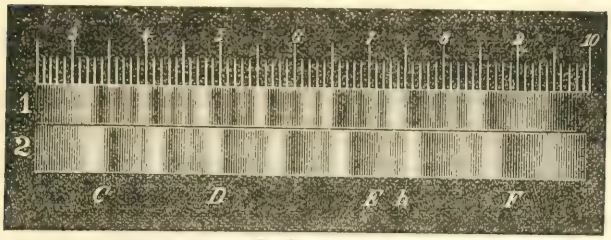
Uranous fluoride, UFl
Potassio-uranous fluoride, $2(UFl)+KFl$
Sodio-uranous fluoride, $2(UFl)+Na$

None of these show any fluorescence, but their absorption spectra are well worthy of note. That of the uranous

* Communicated by President Morton.
† *Zeitschr. f. Chem.*, [2], iii., 353; *Bul. Soc. Chim.*, 1866, ii., 450.

fluoride is shown in 2 of Fig. 14, and that of the potassio salt at 1 of the same figure. One of these (2), as will be observed, consists of broad undivided bands, and the other (1) of bands strongly marked with subdivisions. Both are easily seen by pressing the powder-like substances between slips of glass, either alone or with a little water.*

FIG. 12.

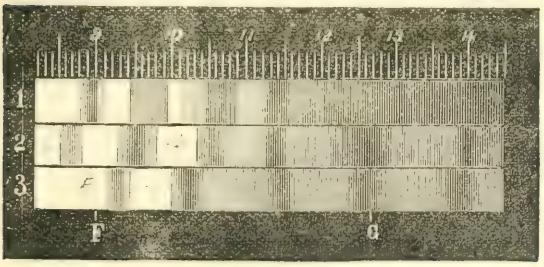


Oxyfluorides.

Uranic Formiate.

This substance gives no fluorescence, and shows an absorption spectrum with faint bands located as follows:—88·5, 98·6, 106·6, 118·1, 129·2, 138·0.

FIG. 13.



Oxyfluorides.

Uranic Nitrate, $U_2O_3NO_5+6HO$.

The uranic nitrate fluoresces very brilliantly, and yields a spectrum of the same general character as the uranic acetate, sulphate, phosphate, &c.; in fact, the normal uranic spectrum. It also shows an absorption spectrum of well-marked and regularly disposed bands.

Both these spectra are well indicated in 1 of Fig. 1, with the exception that the absorption-band close upon F does not appear remarkably strong as the engraving might indicate, but, on the contrary, very weak. In the original drawing it was so marked to keep out of the fluorescent-band, with which it is almost or quite coincident. The spectra are thoroughly discussed by Hagenbach*, and the former by Becquerel.† We have drawn attention already to the displacement suffered by the absorption-bands of this salt by change of solvent. Its neutral solution in water has a very faint fluorescence

Oxalates.

The salts of this class examined are the uranic oxalate, and the ammonio-, potassio-, and sodio-uranic oxalate.

The Uranic Oxalate, $2U_2O_3,C_4O_6+6HO$.—This is one of the salts observed by Stokes (See *Phil. Trans.*, 1852, part ii., p. 521). Its fluorescent spectrum is brilliant and well-marked, and consists of rather narrow bright bands showing what we have already described as the normal characteristics of uranic salts. The centres of its bands are located as follows:—

Fluorescent Spectrum of the Uranic Oxalate.

Bands.	1.	2.	3.	4.	5.	6.	7.
	—	40·0	48·8	47·5	67·0	77·0	89·3

This salt has also a very well-marked absorption spectrum, in which the bands are regular in spacing and intensity. Their centres are located as follows, and are affected by solution and heat, as has been already stated, and is here shown.

Absorption Spectrum of Uranic Oxalate.

Bands.	1.	2.	3	4.	5.	6.
Solid	98·0	108·0	118·8	130·0	139·6	152·0
Cold solution ..	97·5	107·8	118·4	127·4	137·2	150·6
Hot solution ..	97·0	107·4	117·3	125·5	136·0	148·2

The first three bands of this spectrum are very strong and black, and form a characteristic feature of the substance. They are the three noticed by Stokes.

Ammonio-Uranic Oxalate, $NH_4O.U_2O_3,C_4O_6+4HO$.—This salt is readily prepared by dissolving uranic oxalate in a solution of ammonia oxalate, and crystallises readily in strongly marked trimetric prisms. Its fluorescence is strong, and its bands are located as follows:—These bands resemble in appearance those of the double acetates, and the measurements are made at the brightest parts of each band.

Fluorescent-Bands of the Ammonio-Uranic Oxalate.

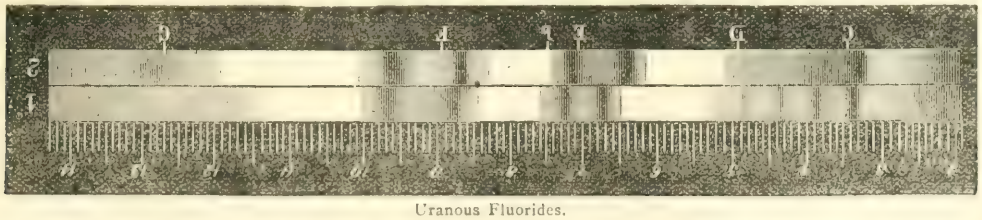
Bands.	1.	2.	3.	4.	5.	6.
	38·8	46·8	55·5	64·8	75·2	87·6

This salt shows also a well-marked absorption spectrum in which the bands (like those of the fluorescent spectrum just given) differ from the corresponding ones of the uranic oxalate by being much lower in the spectrum.

Absorption-Bands of the Ammonio-Uranic Oxalate.

Bands.	1.	2.	3.	4.	5.	6.
	96·4	106·6	117·6	124·0	136·0	148·0

FIG. 14.



Uranous Fluorides.

Potassio- and Sodio-Oxalates. KOU_2O_3,C_4O_6+3HO and $NaOU_2O_3,C_4O_6+3HO$.—These salts are readily formed by dissolving uranic oxalate in solutions of potassic or sodic oxalate respectively. The potassic salt crystallises readily in large masses, forming monoclinic prisms, and the sodic salt in small crystals. The fluorescence of these was in both cases so weak that only three bright bands could be distinguished at all, and these seemed to correspond with the bands of the ammonia salt. The absorp-

* Some portion of this work has been carried out after Dr. Bolton's departure for Europe, and in the present case, being unable to consult with him, I think it best to state, on my own responsibility only, a point which comes up in this place. The sodio-uranous fluoride prepared by Dr. Bolton shows the same spectrum as the uranous fluoride. In his original paper, Dr. Bolton marks it as doubtful, and, in noting its reactions, mentions some which agree exactly with those of uranous fluoride. I am therefore inclined to think that the material heretofore egarded as the sodio-uranous fluoride is a mixture.—H. M.

* *Pogg. Ann.*, 1872, vol. cxlvi., p. 395.

† *Ann. de Chem. et de Phys.*, 1872, vol. xxvii., p. 569.

tion spectrum of the potassic salt was well defined as follows:—

Absorption-Bands of Potassio-Uranic Oxalate.

Bands.	1.	2.	3.	4.	5.	6.
	97·5	106·6	115·8	125·5	135·4	149·0

The sodio-uranic oxalate shows so feeble an absorption spectrum that three bands only can be recognised at 94·9, 104·6, and 116·5 respectively.

In solution, all these oxalates yield absorption spectra, which are very well marked and seem to be identical, carrying out the idea before suggested as to the breaking up of double salts when dissolved.

(To be continued.)

ON THE

ACTION OF BROMINE ON THE WATER-SALTS OF SUCCINIC, MALIC, MALEIC, AND PYRO-CITRIC ACIDS,

CRITICALLY EXAMINED AND INTERPRETED FROM THE STANDPOINT OF THE "TYPO-NUCLEUS" THEORY.

By OTTO RICHTER, Ph.D.

In my two papers on the chemical constitution of succinic, malic, tartaric, and citric acids, I have endeavoured to embrace, by one theory, that particular section of mono- and poly-basic water-salts which are descended from the olefine-begotten polyatomic alcohols, and it is with the view of still more fully developing and substantiating that theory, that I have bethought myself of extending my speculative labours in a new direction, and with a different choice of materials. A rich and plentiful supply of suitable materials has been found to spring from the action of bromine on the water-salts of succinic, malic, maleic, and pyro-citric acids, as also on their pure or chlorinated anhydrides. This searching and powerful reagent is understood to vary greatly in its effects, according as it is administered in the dry state or in the presence of water; but, considering the vast magnitude of my subject, an exhaustive article on which would far exceed the limits of this paper, I have deemed it advisable to confine my remarks to the action of bromine on the aforesaid water-salts only, and while it is applied in a watery solution.

I may now state, by way of introduction, that my interpretation of this order of chemical phenomena is founded on the hypothesis that there exist three different modes or methods, according to which bromine in solution is capable of manifesting its chemical affinities. By the first of these methods, 2 molecules of bromine are supposed to unite directly with 2 mols. of water, with production of 2 mols. of bromo-peroxide of hydrogen, $2H_2Br_2O_2$, the oxygen of which is thus rendered more easily available for oxidising purposes, while the 2 mols. of hydrobromic acid are set at liberty or otherwise disposed of. By the second method, 2 mols. of bromine are supposed to combine directly with a given simple or complex carbon adjunct, and precisely in the same manner as 2 hydrogen molecules are wont to do, with this difference, however, that in the former case the recipient must always be a pure carbon adjunct, while in the latter case it may also be a hydrocarbon adjunct. By the third method, one of the 2 conspiring mols. of bromine is supposed to appropriate a molecule of hydrogen from a given simple or complex hydrocarbon adjunct, with formation of a molecule of hydrobromic acid, while the other molecule of bromine is made to step into its place.

This hypothesis of a threefold mode of action, of which bromine is susceptible, appears to me so natural and reasonable, that I have not scrupled to adopt it as a safe and trustworthy guide while entering upon this new field of research. But before doing so, it is proper to state that the programme I intend to follow consists of two parts: in the first part I shall expound the molecular changes that accompany the action of bromine on the water-salts of succinic, malic, and maleic acids; in the second part I shall elucidate the molecular changes that attend the action of bromine on the water-salts of pyro-citric acid. Let us then, without further delay, examine into the contents of the first part.

PART I.

On the Principal Molecular Changes that Accompany the Action of Bromine on the Water-Salts of Succinic, Malic, and Maleic Acids.

When the ordinary succinate is treated with bromine, the resulting substitution products, chiefly amounting to two, are the bromo-succinate—

$$\frac{H_2O_2.\ H_2O_2.\ H_2O_2.}{2C_2\,;\,H_2Br_2 - 2C_2\,;\,H_2O_2\,;\,2C_2O - 2C_2O_3},$$

and the dibromo-succinate—

$$\frac{H_2O_2.\quad H_2O_2.}{2C_2\,;\,H_2Br_2 - 2C_2\,;\,H_2Br_2\,;\,2C_2O_3 - 2C_2O_3}.$$

Both these compounds are engendered by the first method, consequently the accompanying molecular changes will consist, for the first compound, in the oxidation of the formous acid ally, at the expense of the newly-formed bromo-peroxide of hydrogen, and transposition of one of the hydrobromic acid molecules with the formylic alcohol principal, while the other is set at liberty; and, for the second compound, in the oxidation of the formous acid principal, and transposition of one of the hydrobromic acid molecules with the formylic alcohol ally, while the other is set at liberty.

When the ordinary malate is treated with bromine, the resulting substitution product is the bromo-malate—

$$\frac{H_2O_2.\ H_2O_2.\quad H_2O_2.}{2C_2\,;\,H_2Br_2 - 2C_2\,;\,H_2O_2\,;\,2C_2O_3 - 2C_2O_3},$$

where the same explanation holds good. This view of the molecular structure of the aforesaid brominated derivatives is also fully borne out by experiment. Thus, when a solution of the bromo-succinate is heated with oxide of silver, the bromide of that metal is precipitated, and the solution is found to hold the ordinary malate, clearly showing that the metamorphosis is accomplished by the newly-formed hydrate of silver transposing with the formyl-bromide principal. Similarly, when a salt of the dibromo-succinate is boiled with water or excess of base, the bromide of the metal is formed, in some cases with elimination of both bromine molecules, in others of one only. For instance, the soda-salt is, under this treatment observed to resolve itself into 1 mol. of sodium bromide and 1 mol. of bromo-malate of soda; whereas the silver-salt deposits 2 molecules of bromide of silver, while the inactive modification of the tartrate of water remains in solution. The baryta-salt, on the other hand, is found to differ from the two former salts in this respect, that by the loss of 2 mols. of water the previously-formed bromo-malate of baryta becomes converted into the bromo-maléate of baryta—

$$\alpha)\quad \frac{Ba_2O_3.\quad H_2O_2.}{2(C_2 : C_2)\,;\,H_2Br_2\,;\,2C_2O_3 - 2C_2O_3},$$

$$\beta)\quad 2C_4\,;$$

whence the bromo-maléate of water may be easily obtained with the aid of sulphate of water. The same compound may also be procured by heating the bibromo-succinate, a molecule of hydrobromic acid being expelled at the same time.

It would, further, be interesting to ascertain whether the oxymaléate, which Bourgoin professes to have realised by heating the bromo-maléate with oxide of silver, is identical with the tartrélate—

$$\alpha)\quad \frac{H_2O_2.\ H_2O_2.\quad H_2O_2.}{2(C_2 : C_2)\,;\,H_2O_2\,;\,2C_2O_3 - 2C_2O_3},$$

$$\beta)\quad 2C_4\,;$$

with which it shares the same formula.

SYNOPTICAL ARRANGEMENT OF CHEMICAL FORMULÆ, COMPRISING THE ORTHO AND ISO MODIFICATIONS OF SUCCINIC, MALIC, AND MALEIC ACIDS, TOGETHER WITH THEIR BROMINE-SUBSTITUTED DERIVATIVES.

Ortho Series.

Ortho succinate—

$$\overline{2C_2 ; H_2O_2 - 2C_2 ; H_2O_2 : 2C_2O - 2C_2O}.$$

Ortho-bromo-succinate—

$$\overline{2C_2 ; H_2Br_2 - 2C_2 ; H_2O_2 : 2C_2O - 2C_2O_3}.$$

Ortho-bibromo-succinate—

$$\overline{2C_2 ; H_2Br_2 - 2C_2 ; H_2Br_2 : 2C_2O_3 - 2C_2O_3}.$$

Ortho-malate—

$$\overline{2C_2 ; H_2O_2 - 2C_2 ; H_2O_2 : 2C_2O - 2C_2O_3}.$$

Ortho-bromo-malate—

$$\overline{2C_2 ; H_2Br_2 - 2C_2 ; H_2O_2 : 2C_2O_3 - 2C_2O_3}.$$

Ortho-bibromo-malate—

$$\overline{2C_2 ; H_2Br_2 - 2C_2 ; H_2Br_2 : 2C_2O_3 - 2C_2O_5}.$$

Ortho-maléate—

$$\alpha)\ \overline{2(C_2 : C_2) ; H_2O_2 : 2C_2O - 2C_2O_3}.$$
$$\beta)\ 2C_4 ;$$

Ortho-bromo-maléate—

$$\alpha)\ \overline{2(C_2 : C_2) ; H_2Br_2 : 2C_2O_3 - 2C_2O_5}.$$
$$\beta)\ 2C_4 ;$$

Iso Series.

Iso-succinate—

$$\alpha)\ \overline{2(H_2C_2 : C_2) ; H_2O_2 : 2C_2O - 2C_2O_3}.$$
$$\beta)\ 2H_2C_4 ;$$

Iso-bromo-succinate—

$$\alpha)\ \overline{2(H_2C_2 : C_2) ; H_2Br_2 : 2C_2O_3 - 2C_2O_3}.$$
$$\beta)\ 2H_2C_4 ;$$

Iso-bibromo-succinate—

$$\alpha)\ \overline{2(HC_2Br : C_2) ; H_2Br_2 : 2C_2O_3 - 2C_2O_3}.$$
$$\beta)\ 2HC_4Br ;$$

Iso-tribromo-succinate—

$$\alpha)\ \overline{2(C_2Br_2 : C_2) ; H_2Br_2 : 2C_2O_3 - 2C_2O_3}.$$
$$\beta)\ 2C_4Br_2 ;$$

Iso-malate—

$$\alpha)\ \overline{2(H_2C_2 : C_2) ; H_2O_2 : 2C_2O_3 - 2C_2O_3}.$$
$$\beta)\ 2H_2C_4 ;$$

Iso-bromo-malate—

$$\alpha)\ \overline{2(H_2C_2 : C_2) ; H_2Br_2 : 2C_2O_3 - 2C_2O_5}.$$
$$\beta)\ 2H_2C_4 ;$$

Iso-bibromo-malate—

$$\alpha)\ \overline{2(HC_2Br : C_2) ; H_2Br_2 : 2C_2O_3 - 2C_2O_5}.$$
$$\beta)\ 2HC_4Br ;$$

Iso-tribromo-malate—

$$\alpha)\ \overline{2(C_2Br_2 : C_2) ; H_2Br_2 : 2C_2O_3 - 2C_2O_5}.$$
$$\beta)\ 2C_4Br_2 ;$$

Iso-maléate—

$$\overline{2H_2C_2 ; 2C_2 : 2C_2O_3 : 2C_2O_3}.$$

Iso-bromo-maléate—

$$\overline{2HC_2Br ; 2C_2 : 2C_2O_3 : 2C_2O_3}.$$

Iso-bibromo-maléate—

$$\overline{2C_2Br_2 ; 2C_2 : 2C_2O_3 : 2C_2O_3}.$$

Reverting again to the dibromo-succinate, it deserves to be noticed that this substance may likewise be produced by the action of bromine on the β-maléate (fumarate)—

$$\overline{2C_4 : H_2O_2 : 2C_2O - 2C_2O_3}.$$

In this reaction the first method is held to come again into operation, with this difference only, that the second molecule of hydrobromic acid, instead of being disengaged, is instantly made to react upon the freshly-formed deacetyl-bromide, with production of the de-ethylen-dibromide—

$$2C_2 ; H_2Br_2 - 2C_2 ; H_2Br_2,$$

which, in conjunction with the two oxalic acid constituents, composes the dibromo-succinate. On the other hand, and in striking contrast therewith, it is found that, when the α-maléate

$$\overline{2(C_2 : C_2) ; H_2O_2 : 2C_2O - 2C_2O_3},$$

is treated with bromine, by far the greater portion merges into the iso-dibromo-succinate—

$$\overline{2(HC_2Br : C_2) ; H_2Br_2 : 2C_2O_3 - 2C_2O_3},$$

while the small quantity of ortho-dibromo-succinate is evidently due to the admixture of the β-maléate, into which a corresponding portion of the α-maléate had previously been converted.

In order to explain the accompanying molecular changes, I have recourse to the second method, according to which the bromine unites directly with the complex carbon adjunct, so as to yield the compound—

$$\overline{2(C_2Br_2 : C_2) ; H_2O_2 : 2C_2O - 2C_2O_3}.$$

Subsequently, 2 mols. of water suffer decomposition, their oxygen uniting with the formous acid principal, while their hydrogen, by acting upon the dibrominated carbon

adjunct in conformity with the third method, gives rise to a molecule of hydrobromic acid, which, by transposing with the colligated alcohol, produces the iso-dibromo-succinate as formulated above. When this substance is heated to 180°, it resolves itself into hydrobromic acid and the iso-bromo-maléate—

$$\frac{H_2O_2.\quad H_2O_2.}{2HC_2Br\,;\,2C_2\,:\,2C_2O_3\,:\,2C_2O_3},$$

which may be regarded as a brominated derivative of the iso-maléate—

$$\frac{H_2O_2.\quad H_2O_2.}{2H_2C_2\,;\,2C_2\,:\,2C_2O_3\frown 2C_2O_3}.$$

In this process the formen constituent assumes the form of an acid carbon nucleus, while the residual bromo-methylen constituent re-unites with that nucleus as an adjunct. At the same time, the system undergoes that species of typical metamorphosis which transfers it from the class of alcohol-conjugated water-salts to the class of hydrocarbon-conjugated water-salts.

I may mention here, *en passant*, that the iso-maléate just alluded to was first obtained by Kämmerer from the iso-malate. This substance had been discovered in a silver-bath prepared for photographic purposes, and, on being treated with perchloride of phosphorus, gave rise to a chloride which, under the influence of water, resolved itself into hydrochloric acid and the iso-maléate in question.

I may further state that the action of bromine in excess on the succinate is observed to give birth to the iso-bibromo-maléate—

$$\frac{H_2O_2.\quad H_2O_2.}{2C_2Br_2\,;\,2C_2\,:\,2C_2O_3\frown 2C_2O_3},$$

which may be a direct substitution-product of the iso-bromo-maléate, or else a product of decomposition of a previously-formed iso-tribromo-succinate—

$$\frac{H_2O_2.\quad H_2O_2.}{2(C_2Br_2\,:\,C_2)\,;\,H_2Br_2\,:\,2C_2O_3\frown 2C_2O_3\,;}$$

and I have no doubt that, ere long, and unless they have already been realised, the brominated derivatives of the malate and iso-malate will be added to our collection of curious and interesting chemical preparations. For their respective formulæ the reader is now referred to the annexed scheme (see preceding page).

(To be continued.)

NOTE ON THE COMPOUND OF STARCH WITH IODINE.

By E. SONSTADT.

Some starch was kept for more than two months in a solution of salts containing more free iodine than the starch could take up. The iodised starch was then washed for a fortnight on a filter, by which time the water came through very nearly colourless; it was then further washed by decantation until the water was colourless after settling. The iodised starch thus prepared was black, and had little, if any, odour. A portion of it, air-dried, was found to contain 3·2 per cent of iodine. Another portion was then heated in an oven for a long while at a temperature somewhat higher than that of a water-bath. While drying, it smelt perceptibly of iodine, but, when thoroughly dry, it was perfectly free from odour, and the colour remained black. This stove-dried compound, heated in a closed tube, gave off no trace of free iodine, but a small quantity of a yellowish vapour came off, of a pungent odour, attacking the eyes, and condensing in the cool part of the tube in drops. The heat was then raised to redness, and the charcoal formed examined for iodine, which it proved to contain.

The stove-dried compound is extremely stable, and the ordinary reagents attack it very slowly; it could not be analysed by treatment with solution of thiosulphate of sodium, or of chlorine. A solution of the former, in excess, failed to decolourise it after a week's treatment, with frequent shaking. It was prepared for analysis by moistening it with a strong solution of hydrate of sodium, and heating to redness, and the iodine was estimated in the solution of the residue by chlorine-water. It contained 3·2 per cent of iodine, the same percentage of iodine as was contained in the air-dried specimen.

Another portion of the stove-dried compound was charred at a gentle heat, continued for about an hour, in a covered crucible, and at the last the heat was raised for about ten minutes to low redness. The charcoal proved, on analysis, to contain 3·2 per cent of iodine, equal to 19·64 per cent of the iodine contained in the specimen before its conversion into charcoal. Thus, about four-fifths of the iodine contained in the strongly-dried iodised starch is driven off (though not as free iodine) by charring at a red heat, and a fifth of the iodine remains with the charcoal formed.

ON THE ESTIMATION OF SULPHUR IN PIG-IRONS, &c.

By CHARLES H. PIESSE,
Public Analyst for the Strand District.

A simple and ready method of estimating the sulphur in pig-irons and steels, and one requiring but little attention, is as follows:—

Place into a beaker of about 300 c.c. capacity about 3·5 to 4 grms. of the sample, in drillings (weighed to within 0·01 grm. will be sufficiently accurate), and pour upon them 35 to 40 c.c. of aqua regia, consisting of 1 part HNO_3 with 2 parts HCl, maintaining the proportion of 10 c.c. of the mixed acids for every 1 grm. of the metal, keeping the beaker covered as well as possible with a clock-glass. After the first violence of the action has subsided, boil the liquid for a few moments until the whole of the iron is dissolved, then transfer the solution, with as little washing as may be, to a porcelain basin, and evaporate as nearly as possible to dryness on a water-bath. Treat the residue with some concentrated HCl, add about an equal bulk of water, and then filter. To the filtrate add a considerable excess of $BaCl_2$ solution, allow to stand for about twelve hours; filter, and weigh the precipitated $BaSO_4$ with the usual precautions. Multiply the weight of $BaSO_4$ found by 13·724, and divide the product by the weight of the iron employed; the result will be the percentage of S in the sample analysed.

Laboratory, 303, Strand, London.

NOTE FROM THE LABORATORY OF CHARING CROSS HOSPITAL.

By THOMAS BOLAS.

On the Ferrous Sulphate Test for Nitric Acid, and its Employment as an Approximate Indicator of the Amount of Nitrates in Potable Water.

In performing this test, it is more advantageous to float the liquid under examination on a solution of ferrous sulphate in oil of vitriol, than to follow the usual method of floating an aqueous solution of ferrous sulphate on the suspected fluid mixed with oil of vitriol. The sulphuric solution of ferrous sulphate is best prepared by mixing oil of vitriol with 10 per cent (by volume) of a cold saturated solution of ferrous sulphate, and heating the mixture sufficiently to decompose any of the olive-green compound which may arise from the accidental presence of nitric acid in the oil of vitriol employed. When cold, the

colourless solution is ready for use, and it may be labelled "Nitric Acid Test." It is convenient to introduce the fluid to be tested by means of a pipette having the delivery-end bent once at a right angle, and the charged pipette should be placed against the side of the test-tube, about an eighth of an inch above the surface of the vitriolic solution, and then the finger should be removed from the upper end of the pipette to allow the liquid to flow. It is, moreover, necessary to use a pipette having a rather small opening, otherwise the rush of fluid causes considerable agitation.

By adopting this modification of the well-known sulphate of iron test, two principal advantages are attained—in the first place, it is unnecessary to test the sulphuric acid each time it is used, and, in the second place, the loss of time required to cool the usual mixture is avoided; moreover, the "nitric acid test," unlike aqueous ferrous sulphate, remains clear and always ready for use.

Attempts were made to estimate the nitric acid in potable waters by comparing the tints produced on floating them on "nitric acid test" with those produced when standard solutions of nitre are similarly treated, but in this case so much depends on delicacy of manipulation in pouring on the lighter fluid, that the results obtained were not so constant as might be desired, but if the water to be tested is carefully run in with a pipette as above described, and if the standard solutions of nitre are similarly treated, results are obtained which, in the course of a few seconds, indicate the approximate amount of nitrates contained in water. In cases where the amount of nitrates is small, a beaker may be advantageously substituted for a test-tube, and, in any case, the vessel in which the testing is performed should be steadily fixed during the operation.

The salt which separates on cooling the hot "nitric acid test" is under examination.

Charing Cross Hospital,
Nov. 10, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Moniteur Scientifique, du Dr. Quesneville, October 1873.

Modern Progress of Industrial Chemistry.—Aimé Girard.—A popular address delivered at the Lyon meeting of the French Association for the Advancement of Science. It has been already noticed in the CHEMICAL NEWS.

Part Played by Septic Agents in the Animal System.—Fernand Papillon.—A physiological paper of considerable interest.

Theory of Tanning.—M. A. Reimer.—A continuation of the treatise which we have already noticed.

On Atmospheric Ozone.—M. Ebermayer.—An essay on the causes which promote the spread of epidemics, and the precautions to be adopted for their restriction.

Volumetric Determination of Bismuth.—MM. Buisson and Ferray.—The method in question is based upon the complete precipitation of bismuth by iodic acid in an acetic solution. The iodate of bismuth is a white anhydrous powder, $Bi_2O_3.3IO_5$, insoluble in water and acids. This method is applicable to the determination of all compounds into which bismuth enters. The assay of a sample of subnitrate of bismuth is made by dissolving half a gramme of this salt in a few drops of nitric acid, and diluting slightly with water. The liquid is saturated with bicarbonate of soda until a slight permanent precipitate appears. This precipitate is re-dissolved by acetic acid in excess so as to hinder the partial precipitation of bismuth on the subsequent addition of water. The liquid is then boiled and filtered to separate the iron and oxychloride of bismuth which may be present. To the filtrate we add 25 c.c. of iodic acid, and water enough to make up 250 c.c. It is well stirred, and after being allowed to settle for a few moments the liquid is poured upon a dry filter. To 100 c.c. of the clear liquid we add dilute sulphuric acid and iodide of potassium, so as to decompose the iodic acid which has not been consumed, and to redissolve the iodine set at liberty, which may be easily recognised when the liquid no longer contains greyish floating particles of iodine. The following equation explains this reaction:—$IO_5+5KI+5SO_3=5SO_3KO+6I$. Into the liquid containing the iodine there is dropped, by means of a burrette graduated into tenths of a c.c., a solution of hyposulphite until the yellow tint of the iodine disappears. The addition of starch is needless, for the disappearance of the yellow tint is a more sensitive indication than the disappearance of the blue colour of the iodide of starch. The difference of the value found on acting upon iodic acid alone, and upon iodic acid after preliminary precipitation with a known weight of pure bismuth renders it possible to calculate the amount of bismuth contained in the sample under examination. It is preferable to express the result as metallic bismuth rather than as subnitrate, the composition of which is still not well known. The authors believe that it contains 68·94 per cent of the metal. If lead or baryta are present they must first be removed as sulphates. Tin and antimony found alloyed with bismuth are converted into insoluble stannic and antimonic acids by treatment with nitric acid. The reagents employed must be free from chlorine, and the iodide of potassium must contain no iodate of potassa. To detect the presence of this impurity dissolve 1 grm. of the sample in 11 c.c. of water, adding a few drops of pure hydrochloric acid, and shaking up with chloroform. If this latter body remains colourless the iodide is pure. The standard solution of iodic acid is prepared by dissolving 30 grms. of the crystalline acid in 1 litre of distilled water, and titrating with the aid of pure bismuth. The solution of iodide of potassium is saturated. The solution of hyposulphite is sufficiently strong when 30 to 40 c.c. serve to oxidise the iodine liberated from 10 c.c. of iodic acid.

Bulletin de la Société Française de Photographie, No. 9, 1873.

Notice on Heliochromy.—M. de Saint-Florent.—The author has succeeded in producing heliochromic proofs, whose colours have the closest relation with the natural colours. Landscapes have been obtained in this manner in the camera, though the colours were rather faint. He steeps a sheet of paper of fine texture in—

Nitrate of silver	20
Distilled water	20

To which, when dissolved, is added—

Alcohol	10
Nitric acid	1

When the paper is dry it is again plunged into—

Hydrochloric acid	50
Alcohol	50
Nitrate of uranium	1

It is necessary to dissolve previously in the hydrochloric acid a little zinc-white, say from 1 to 2 grms. On removal from the bath the paper is exposed to sunlight until it turns a violet-blue. It is then, after drying, plunged anew first into the silver, and then into the hydrochloric bath.

The operations are repeated till a paper is obtained of an intense violet-blue. When quite dry it is placed in the following bath:—Water, 100; acid nitrate of mercury, 4 to 5 drops. The paper is left in this bath five to ten minutes and dried. It is then exposed under a coloured glass, and there is obtained in thirty to forty seconds a proof with a white ground and all the colours of the model. The colours are brighter, and the speed as great if to the foregoing bath be added—

Bichromate of potash (saturated solution) ..	2
Sulphuric acid	2
Chlorate of potassa	1

To fix the image approximately it is washed in much water, and then plunged in—

Ammonia	5
Alcohol	100

The paper is washed and plunged in a saturated solution of an alkaline chloride. After a further washing the proof resists diffused light for a long time. More rapid action is obtained if the chloride of silver paper is allowed to blacken under violet or blue glasses. If on withdrawal from the bath of nitrate of mercury the paper is exposed under a coloured glass, and glasses of different colours are interposed between it and the sun, the proof comes up more rapidly under yellow, green, and red glasses than under blue and violet. To produce landscapes with the camera it is necessary to prevent as far as possible the action of diffused light, and for this purpose to adapt in front of the objective a cardboard cone of suitable length. The time of exposure, with a Darlot's objective of 0·2 metre focal distance, is from fifteen minutes to one hour, using the largest diaphragm, and operating in sunshine.

Proofs with Fatty Inks.—An account of certain specimens sent by M. Rodrigues of the Polytechnic School of Lisbon.

An Account of the Process for Photo-zincography as Employed by the Photographic Section of the General Direction of Geographical Works of Portugal.—The mixture used in the preparation of the plates was—

Water	1000	grms.
Gum arabic	40	,,
Sulphate of copper..	2	,,
Gallic acid	5	,,
Nitric acid	0·5	,,

Dry Collodion Process.—A. de Constant.—The author indicates the conditions necessary for successful work by this process. He recommends the employment of a special collodion made with a cotton prepared at a high temperature, or else already old; to find a covering which whilst acting mechanically to preserve the porosity of the collodion contains also a chemical agent which may intervene usefully for the preservation of the layer, and may aid in the combination of the development; to compose the preparation chosen for covering, so that the dry layer may not contain any element of alteration, and may remain in good condition for some months; to find a means of softening the dried layer, and of restoring to it a sufficient permeability that the developing solution may penetrate and exert its action equally and completely, without making rapidity a capital question, to abridge the exposure as much as possible. Into each of these points the author is about to enter in detail.

Stereoscopic Proofs on Glass, and Various Procedures.—Count Ludovico de Courten.—The author prefers plates preserved with tannin, which he prepares exactly as directed in his "Manuel Pratique." He gives procedures also for cementing positive proofs upon cardboard, for securing solidity in the varnish applied to negative proofs, and for producing moonlight effects.

The Ordinary Wet Collodion Process.—M. Th. Sutton.—The author has been experimenting in order to ascertain with precision the best respective proportions for the soluble iodide and bromide in the wet collodion process. He concludes that a collodion for great rapidity ought to be liberally iodised, and to contain a fair proportion of bromine. The strength of the nitrate bath should not exceed 8 per cent. The bromide of silver he finds is exceedingly sensitive to light without the presence of free nitrate, and this will be the starting-point for a great improvement in the art. The author makes use of a bath prepared more than ten years ago, and which has been in use ever since. He employs pure neutral re-crystallised nitrate, and adds from time to time bicarbonate of soda to the bath, exposing it for a day to the light. The carbonate of silver is then filtered off, and the bath, slightly acidulated with nitrate of silver, is in excellent condition.

Reimann's Färber Zeitung, No. 36, 1873.

The Exhibition in Vienna.—Haahl and Co., of Molenbek (Belgium), exhibit a model of an apparatus for extracting the grease from wool by means of bisulphide of carbon. Schlumberger, of Brussels, exhibits xanthin, artificial indigo, and other coal-tar products. There are receipts for colours upon plush, scarlet, ponceau, crimson, garnet, and medium garnet. The "scarlet spirit" used as a mordant in these formulæ is directed to be made from 14 lbs. tin crystals, 24 lbs. bichloride of tin, and 50 lbs. of hydrochloric acid, fuming, but free from iron. Only the clear part of the mixture is to be employed. There is an article on the arrangement of steam pipes in dye-becks, which contains nothing new to English dyers. Next follow receipts for dyeing cotton a chamois; cotton-yarn a rose by means of annatto and safflower extract; mixed goods a grey; wool a drap, a stone, and a reseda. Reichardt has found, at Jena, sausages dyed with magenta. In this case alcohol extracts the red colour. The so-called "antimony-blue" has been going the round of the technological papers.

No. 37, 1873.

This number contains a full description, with illustration, of Haubold's machine for washing yarn. There are receipts for garnet, light, medium, and dark green, and silver-grey on plush, porcelain white and lemon-yellow on wool. Catechu and sanders are recommended as an addition to the copperas vat in order to save indigo. Next follow prescriptions for steam-printing colours, chiefly olives.

No. 38, 1873.

The New Indigo Vat.—Schützenberger and De Lalande.—It is known that the low stage of oxidation of sulphur obtained on the reduction of sulphurous acid with zinc dissolves indigo. On this reaction the following procedures for dyeing and printing with indigo are founded:—To prepare the reducing liquid a solution of bisulphite of soda at 35° B. is brought in contact with sheet zinc in a closed vessel, of which the liquid should occupy only one-fourth. After the lapse of an hour the zinc is precipitated from the clear liquid by means of milk of lime. It is then diluted and decanted or filtered with exclusion of air. The clear liquid is then poured upon the ground indigo, with the addition of the needful soda and lime. 1 kilo. of indigo yields in this manner a very concentrated vat of 10 to 15 litres. Cotton is dyed cold, and wool with the aid of heat. A vat is filled with water, and a suitable quantity of the above indigo mixture introduced, when the dyeing can be performed at once. The excess of the low sulphur acid dissolves the froth which appears on the surface. During the process of dyeing further quantities of indigo can be added as required. Cotton can be rapidly and easily dyed in this manner; and in the case of wool the dyer escapes the many disadvantages of the hot vat, and obtains brighter and clearer shades. To print a fast blue the alkaline solution of the reduced indigo is printed on with an excess of the reducing agent, aged for twelve to twenty-four hours, washed, and soaped. In comparison with the old process there is a saving of indigo to the extent of 50 to 60 per cent; the shades are richer and the impressions sharper. The colour requires no subsequent

treatment, and can, therefore, be printed on simultaneously with most other colours.

Cotton Dyeing.—There are receipts for a deep rose, a safflower-scarlet, an olive, and a violet on cotton yarns.

Alpaca and Mixed Goods.—The editor gives receipts for a cochineal scarlet, a dark brown, and a black.

Wool Dyeing.—There is a receipt for a Nicholson blue. Woollen piece goods are directed to be worked in a solution of 1 per cent of the colour, and ½ per cent of sulphate of zinc, while the temperature is slowly raised to a boil, which is maintained for an hour. The cloth is taken out, cooled, rinsed in cold water, and placed in a beck containing 2 per cent (on the weight of the goods) of sulphuric acid, and ½ per cent of sulphate of zinc. A single turn in this bath suffices to raise the colour.

Plush Dyeing.—There are receipts for a dahlia, and a magenta and a blue.

Silk Dyeing.—There are receipts for a rose and a sky-blue, which offer nothing remarkable.

Argentine Effect.—Jacobsen stirs up commercial tin (zinc?) powder with a solution of albumen to a paste, which is then printed. The goods are steamed and steeped in a solution of bichloride of tin. The tin dissolves out the zinc, and is deposited in its place. The goods are washed, dried, and run through a glazing machine which polishes the tin. It is proposed—rather grotesquely—to dye drabs and browns with an extract of green walnut shells! Sulphide of cadmium as an undried precipitate, is found to be a good (but expensive) yellow colour for soaps. A permanent red ink is prepared by rubbing up carmine with a solution of soluble glass to the consistence of good writing ink. The writing dries swiftly, and is as bright as a mirror. This ink must be preserved from contact with air. Solution of gum arabic is improved by adding 2 parts of sulphate of alumina to 250 of a solution of gum, made in the proportion of 2 parts of gum to 5 of water. Gum thus prepared is sold as vegetable glue, and serves to cement together surfaces of metal and glass. Dufrené to prevent mouldiness steeps the articles in a dilute solution of tannin, and treats them with a solution of bichromate of potassa till a brown colour is produced. He then washes and dries. (It must be remembered that this process is not applicable to articles of food.)

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Mène, No. 38, 1873.

The greater part of this number is again filled up with non-chemical matter. There is a notice of Siemens's gas-furnaces, which are no longer a novelty, and a short paper on the new process for the manufacture of alkali as worked by M. Solvay, at Couillet, in Belgium. This process, founded on the decomposition of the chloride of sodium by the bicarbonate of ammonia, has been already in operation at Couillet for some time, and now furnishes about one-fourth of the soda actually consumed in Belgium. Hence it is evident that M. Solvay has overcome the difficulties which former inventors such as Turech, Schlœssing, and Roland found insurmountable. M. Solvay has received a diploma of honour at the Vienna Exhibition.

No. 39, 1873.

This number again contains no chemical matter.

Revue Scientifique de la France et de l'Etranger, October 18, 1873.

History of the Chemical Theories of Digestion.—Claude Bernard.—Prof. Claude Bernard, in his course of lectures on general physiology, gives an account of the various theories of digestion entertained by men of science from Hippocrates downwards. The eminent Greek physician considered digestion as a cooking process. Galen maintained the existence of three kinds of digestion, the first performed in the stomach, the second in the duodenum, and the third in the liver; a view taken in later times by Servetus and Drake. Plistonicus, a disciple of Protogoras, identified digestion with putrefaction. Hilmon regarded digestion as fermentation, and divided it into six kinds, a view in which he was followed by Sylvius, Willis, Boyle, and others. The mechanical theory of Borelli, Bœrhaave, and Pitcairn considered digestion to be mere trituration, a view which as far as animal food is concerned was experimentally refuted by Reaumur. This naturalist introduced into the gizzards of birds portions of meat enclosed in perforated metals tubes. On killing the bird after some time the meat was found to have been dissolved. Seeds, however, enclosed in a similar manner resisted the digestive process. Spallanzani succeeded in withdrawing gastric juice from animals, and by its means performed artificial digestion outside the living body. The author concludes with a notice of the observations made upon the celebrated Alexis St. Martin.

October 25, 1873.

This number contains no chemical matter.

NOTES AND QUERIES.

Notes on the Utilisation of Sewage.—(From the "Report of the Main Drainage Committee for 1864," vol. 487).

2163. (To Mr. West). Can you give us any information of the relative cost of the carriage of any substance, such as clay, in a cart, or by suspension in water, by means of pumping?—That will make no difference at all, because we are pumping all the China clay in St. Austell, which is about 200,000 tons a year, and that is thicker than the mud of the Thames, and it does not interfere with the valves at all as long as it is in a liquid state. We pump the mineral water in some of the mines also; half of that is entirely what we call mud.

2175. Does your estimate of the price of pumping depend upon a given price of coals?—Yes, entirely so. I calculate the coals would cost £1 per ton, which is quite sufficient.

2178. (To the same). You have stated that the liquid clay is conveyed in pipes by gravitation; what distance is it so conveyed?—From two to three miles in several places. I have one gentleman close by my land now, about two miles off, who is a large clay merchant, and he tells me that he saves something like £800 a year by carrying the clay in this manner.

2209. (To Mr. Hocking). You stated that if the coal were dearer as between your average of 17s. and 20s., that would increase the cost of lifting; are there not other elements besides coal, such as wear and labour?—We have calculated for labour the price generally paid in this neighbourhood, but the increased price for lifting would not increase in the same ratio as the price of coal increased.

2210. Nor would the wear and tear of the engines?—No.

2211. Then should we have simply to add the cost of coal?—Yes.

2212. What is the maximum height to which you can lift the sewage?—It would be lifted 300 feet in one lift, but I do not think it would be advisable to lift it to that height in one time.

2213. Would it require much stronger pumps for that height?—Yes.

2214. You would require other engines, and another reservoir at the next lift, would you not?—Yes.

2385. (To Mr. Johnson). Upon what data do you ground your opinion that the sewage will not answer when applied to corn crops?—The advantage of sewage, I take it, to grass, is to be divided into two portions: first, the advantage of applying so much pure water; and, secondly, the application of the various matters which are mechanically suspended in, or chemically combined with, that water in the case of sewage. I take it that, in most cases, if the same bulk of water were applied to grass land, it would do a great deal of good in the majority of instances in suitable soils; but with regard to the cereals you do not want moisture; the dryest climates are the best for the most valuable of these cereals, and therefore when you add water to corn land it is adding what the land does not need.

2386. But does not corn land require the fertilising properties of sewage?—Yes; but then I take it that the bulk of water which would be necessary to carry those ammoniacal matters, and that small amount of phosphate of lime which is contained in the sewage, is so great, that the water would be injurious to perhaps a greater extent than the chemical matters wood do good to the land.

2587. (To Mr. Ellis). Do you know of any chemical manufacture at Alnwick?—I cannot say as to that. At Edinburgh they put on considerably more than £100 worth of sewage to the acre, and they only get £30 worth of grass. That is a great failure.

2666. (To Mr. Bateman). Have you found any inconvenience from the application of the sewage?—There has been no inconvenience; the most beautiful application of sewage that I have seen is at Carlisle.

MEETINGS FOR THE WEEK.

THURSDAY, 20th.—Chemical, 8. E. Davies, "On the Chemical Properties of Ammoniated Ammonia Nitrate." Dr. W. J. Russell, "On the Action of Hydrogen on Silver Nitrate."

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Hours of Lecture for Session 1872-73:—

Chemistry (Inorganic)	10 a.m.	Materia Medica	4 p.m.
(Organic)	2 p.m.	Pharmacy	2 p.m.
Botany (Structural) ..	11 a.m.	Classics (Junior)	9 a.m.
,, (Systematic) ..	3 p.m.	,, (Senior)	4 p.m.

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North Road, Highgate, Jan. 9th, 1873.

MR. NICHOLLS.—Dear Sir,—I tried your Application for Gout, from which I have long suffered. I have not had the slightest return of it. With many thanks, I remain, yours truly, WILLIAM ATKINS.

42, Tavistock Terrace, Upper Holloway, 19th April, 1873.

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SUPPLEMENT
TO
THE CHEMICAL NEWS.

VOL. XXVIII. No. 729.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 6, 1873.

Dr. ODLING, F.R.S., President, in the Chair.

THE minutes of the previous meeting having been read, Messrs. Walter Odling and C. W. Vincent were formally admitted Fellows of the Society.

The donations to the Society were then announced by the Secretary, and the following names read for the first time—Messrs. Charles L. Field, Walter T. Goolden, B.A., B. W. Richardson, F.R.S., Donato Tommasi, Edgar Beckit Truman, Thomas H. Davies, William Masters, A. Campbell Dixon, James Baynes, Thomas Jamieson, Robert Williamson, Charles James Hislop Warden, Francis Jones, Sydney Knowles Muspratt, Felix M. Rimmingtons, Edward Cleminshaw, Samuel Herbert Cox, and Arthur B. Kitchener.

For the third time—Messrs. Edward Collens, George Bult Francis, William Edward Porter, John Turner, and William Charles Young, who were ballotted for and duly elected.

Dr. ODLING said it was not customary for the President to address the Fellows at the first meeting of the session, but he could not help saying a few words of welcome and congratulation on their taking possession of their new rooms, and they might regard the assistance they had received from the State, unaccompanied as it was by State control, as some recognition of the advantages of scientific research to the national welfare, and as tending to the mental and moral cultivation of the people. It was necessary for them to have some place of meeting, and it would be impossible for them to provide such handsome rooms as they had now, indeed to provide rooms at all would be a very serious inroad on their funds. He might mention two new features—one the commodious store-room for the spare numbers of their journal, and the other the laboratory adjoining the meeting-room, the primary use of which would be for giving experimental illustrations in connection with the papers brought before the Society. After alluding to the various benefits to be derived from their meeting together, the speaker said that chemical science treated of things that could be handled, and phenomena which could be observed, and the use of the laboratory was offered to those who brought new facts before the Society to illustrate those facts, for we all know the great delight and interest chemists take in witnessing such experiments. With regard to the financial aspect of the matter, they had incurred considerable expense, although the Government had given the gas-fittings and the new book-shelves in the library; however, all that was useful in the old rooms had been removed here, and utilised in one way or other; even the old historic seats, which were formerly those of the Royal Society, formed part of the benches in that room. He could not but tell the Fellows that it was owing to the great exertions of the Junior Secretary, Dr. Russell, that they were enabled to remove to their new rooms in time for this meeting, and throughout the arrangements they had met with the greatest courtesy and kindness both from Mr. Barry, the architect, and also from the Clerk of the Works.

The first paper, "*On the Optical Properties of some Modifications of the Cinchona Alkaloids*," by D. HOWARD, was read by the author. After enumerating the various observations that had been already made on this subject, he drew attention to the approximate relation between the deviation caused by quinicin and cinchonicin and the alkaloids from which they are derived; thus the mean of the specific rotary power of quinine and quinidin in alcoholic solution is 47° to the right, and that of quinicin, corrected for its combined water, 41°, whilst, in aqueous sulphuric acid, they are 20·5° and 19·4° respectively. A similar approximation is found to be the case with cinchonicin as compared with cinchonin and cinchonidin. The action of nascent hydrogen on the alkaloids in acid solution gives rise to compounds which Schützenberger regards as differing from the original compound in containing 1 atom more water; the author, however, is inclined to doubt this, as no evolution of hydrogen occurs when cinchonin or cinchonidin is treated with zinc and dilute sulphuric acid until a considerable excess of the acid has been added: the optical properties of the bodies formed are very similar to those of quinicin and cinchonicin. The author then proceeded to describe the method of preparation and optical properties of the various ethyl bases produced by the action of ethyl iodide or bromide on the cinchona alkaloids: the rotation produced by the salts of the ethyl bases is in most cases very nearly proportional to that which would be given by a salt of the original alkaloid, equal in amount to that contained in the new compound.

The PRESIDENT thanked the author in the name of the Society for his interesting memoir, and hoped he would take advantage of his great opportunities, and give the Society some further results of his experiments.

Dr. FRANKLAND had listened with much interest to Mr. Howard's account of the alteration produced on the polarised ray by the effect of combination. It was a matter of great importance to accumulate results on this subject, so as to endeavour to ascertain what circular polarisation means, chemically speaking. The alteration in the intensity is not only produced by combining two substances of opposite rotary powers, but sometimes also by the combination of a rotary body with a neutral one. He would like to ask the author whether he had ever observed amongst the cinchona alkaloids an instance in which combination with an indifferent body had caused a reversal of the rotation of the polarised ray.

Dr. WRIGHT suggested to the author that he should determine the heat of combustion of some of these isomerides, to see whether there was any relation between the heat evolved and the rotary power, somewhat similar to that which had been observed in many volatile bodies between the heat of combustion, and the boiling-point.

Mr. HOWARD replied that he had not found any instance in which inversion of the rotary power took place where the altered compound could be re-converted into the original substance. In dealing with bodies of so complex a nature and so delicate a structure, which were so very easily destroyed, the difficulty was to find cases where they give satisfactory results at all.

Dr. C. R. A. WRIGHT then read a "*Preliminary Notice on the Oils of Wormwood and Citronella.*" The portion of oil of wormwood boiling between 195° and 200°, and termed by Gladstone *absinthol*, $C_{10}H_{16}O$, when treated with phosphorus pentasulphide, is decomposed, a hydrocarbon being produced which boils at 170° to 180°, and a yellowish oil boiling at 230° and upwards. The hydrocarbon, after purification, boiled at about 176°, and, on analysis, appeared to be cymen, produced in the reaction—

$$C_{10}H_{16}O - H_2O = C_{10}H_{14}.$$

The yellowish liquid boils at about 235°, and is chiefly *thio-cymen* or *cymyl-sulphydrate*, identical with that recently obtained by Fliesch from camphor. Oil of citronella, when distilled, yields an unstable body of the formula

$C_{10}H_{18}O$, which unites with bromine, and the product, $C_{10}H_{18}Br_2O$, when heated, splits up thus—

$$C_{10}H_{18}Br_2O = H_2O + 2HBr + C_{10}H_{14}.$$

The resulting cymen is apparently identical with that already known.

The PRESIDENT, having thanked the author for his communication, called on Mr. W. F. DONKIN to read his paper "*On the Estimation of Nitrates in Potable Waters*." This process is founded on the reaction that a nitrate in the presence of chlorides, when treated with phenol and sulphuric acid, gives a reddish solution, which, on the addition of an excess of ammonia, changes to a more or less decided blue; this gradually becomes more intense on standing. The water under examination is compared with a standard solution of potassium nitrate containing a known quantity of the salt; these are treated in a precisely similar manner. The process is capable of accurately determining the amount of nitrates present to within 1 part in 4,000,000 of water; it is, however, necessary to closely observe certain details given in the paper, in order to insure this result, slight variations in the manner of conducting the operations or in the quantities of the reagents employed producing corresponding variations in the depth of tint obtained.

Dr. ODLING said the determination of the amount of nitrates in water was a subject of interest to many of the Fellows present, and if an easy process for determining ammonia could be devised, it would be a boon to water analysts all over the country.

Dr. FRANKLAND remarked that, although much attention had been devoted to the determination of nitrates and nitrites in waters, there was still room for another process. The aluminium process answered admirably with a water which gave a large residue with comparatively little organic matter, and the mercury and sulphuric acid process when much nitrate was present, but it was not trustworthy when the amount of the latter was very small. In those cases where there was a large residue and a large amount of organic matter, he hoped the new process might prove available, but he thought the accuracy of the method had not been pushed far enough. The mercury process fails when the amount present in the water is less than 0·01 in 100,000. He would like to ask the author whether he had made any experiments on such minute quantities.

Mr. W. THORP congratulated Mr. Donkin on obtaining such good results with a colour process, the difference detected being about 1½ per cent on the total quantity, whilst with the Nessler test it required a practised eye to detect a difference of 2½ per cent. He thought, when the amount of nitrates was but small, that the mercury and sulphuric process was rendered thoroughly satisfactory by adding a known quantity of a standard solution of a nitrate to the water previous to evaporation, the object being to obtain a measurable quantity of gas, thus overcoming the difficulties which were merely mechanical.

Mr. DONKIN, in answer to Dr. Frankland, said he had not made further experiments on very small quantities of nitrates: he had examined a water containing a large amount of residue, which yielded a faint blue tint, but had not tested for nitrates by any other process. One of the great advantages of the method was its rapidity; half-a-dozen determinations could easily be made in a morning.

The Secretary then read a "*Note on the Action of Iodine Trichloride upon Carbon Disulphide*," by Mr. J. B. HANNAY. The author finds that the result of the action of pure carbon disulphide on iodine trichloride is represented by the equation—

$$4CS_2 + 6ICl_3 = 2ClCCl_4 + 2CSCl_2 + 3S_2Cl_2 + 3I.$$

and suggests that the different results obtained by Weber were probably owing to the iodine trichloride he employed containing monochloride. The author prepares the pure trichloride by passing chlorine over iodine in a retort, with occasional agitation, until a reddish yellow solid is produced. Heat is then applied, and a yellow sublimate of the trichloride is formed in the receiver, whilst monochloride is left behind; this is again chlorinated, and again sublimed, until the whole is transformed into the trichloride.

The PRESIDENT, after expressing thanks for Mr. Hannay's paper, adjourned the meeting until Thursday, the 20th of November.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, November 3rd., 1873.

GEORGE BUSK, F.R.S., Treasurer in the Chair.

THE Secretary announced the decease of Sir Henry Holland, the President, on October 27.

Henry Adolphus Focking, and Major John Andover Wood were elected Members of the Royal Institution.

The special thanks of the members were given to Charles Woodward, F.R.S., for his present of his work on the "Polarisation of Light," and of much valuable apparatus illustrating the subject; and also to William Salmon, M.R.I. for his donation of ten pounds for the promotion of scientific research in the Royal Institution.

The presents received since the last meeting were laid on the table, and the thanks of the members returned for the same.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 7th, 1873.

E. W. BINNEY, F.R.S., F.GS., Vice-President, in the Chair.

MR. SAMUEL BROUGHTON was elected Treasurer of the Society in place of the late Mr. Thomas Carrick.

"*Atmospheric Refraction and the Last Rays of the Setting Sun*," by DAVID WINSTANLEY.

It is recorded in the Proceedings of this Society that a letter dated from Southport, and written by Dr. Joule, was read at the meeting held on the 5th October, 1869. In that letter it is remarked that "Mr. Baxendell noticed the fact that at the moment of the departure of the sun below the horizon the last glimpse is coloured bluish-green." Dr. Joule also observes that on two or three occasions he had himself noticed the phenomenon in question, and that "just at the upper edge where bands of the sun's disc are separated one after the other by refraction, each band becomes coloured blue just before it vanishes."

During the past eighteen months the writer, from his residence in Blackpool, has had frequent opportunities of observing the setting sun, and has noticed the phenomenon of the final coloured ray certainly more than fifty times. To the naked eye its appearance has generally been that of a green spark of large size and great intensity, very similar to one of the effects seen when the sun shines upon a well-cut diamond. The colour, however, is by no means constant, being often, as in the case of Mr. Baxendell's observation, bluish-green, and at times is mentioned by Dr. Joule, quite blue. The period of its duration, too, is likewise variable. Sometimes it lasts but half a second, ordinarily perhaps a second and a quarter, and occasionally as much as two seconds and a half.

When examined with the assistance of a telescope, it becomes evident that the green ray results at a certain stage of the solar obscuration, for it begins at the points or cusps of the visible segment of the sun, and when the "setting" is nearly complete extends from both cusps to the central space between, where it produces the momentary and intense spark of coloured light visible to the unaided eye.

From the fact of the green cusps being rounded I apprehend that irradiation contributes to the apparent

magnitude of what is seen. The range of colour, too, as seen in the telescope, is more varied, and the duration of the whole phenomenon more extended, than when the observation is made only with the naked eye.

Of the objective nature of the phenomenon it is needless to offer evidence; for it needs to be but seldom seen to preclude the idea of an optical illusion. That the waters of the ocean have nothing to do with the production of the colour is made manifest by its visibility when the sun "sets" behind the edge of a well-defined cloud. On the 14th and 15th of June, for instance, it was seen at upper contact of the solar limb with clouds. On the earlier date in question a thin band of cloud stretched across the setting sun, and under a power of fifteen diameters the green effect was seen at upper contact with the cloud, and again at final disappearance below the horizon. On the later date it was again seen at upper contact with each of several filaments of cloud, and again at final disappearance. And on several other occasions the writer has observed the effect when the disappearance of the sun has taken place at an elevation of six or eight degrees behind a heavy bank of clouds.

Respecting the increased range of colours seen when the phenomenon is observed with telescopic aid, I may mention that on the 28th of June the sea was calm and the sky quite cloudless at the setting of the sun. Of the final coloured rays fifteen diameters showed the first to be a full and splendid yellow, which was speedily followed by the usual green, and then, for a second and a half, by a full and perfect blue. Respecting the increased duration of the colour, I have found that when the atmosphere is sufficiently favourable to allow a power of sixty diameters being employed, with a 3-inch object-glass, the green effect is seen at that part of the sun's limb in contact with the horizon, even when one-half the sun is still unset, and of course from then till final disappearance.

The different colours seen, together with the order of their appearance, are suggestive of the prismatic action of the atmosphere as the cause of their production, and the interception of the horizon or the cloud as the cause of their separation.

Assuming the correctness of this view, it becomes evident that an artificial horizon would prove equally efficacious in separating the coloured bands, and also that if employed during an inspection of the sun's lower limb the least refrangible end of the spectrum would be disclosed. Accordingly I introduced into an eyepiece of my telescope a blackened disc of metallic copper, having a slit cut in it of about the one hundred and fiftieth of an inch in width, and proceeded to make an observation, in July, when the sun was about one-half of its meridian height. The blinding glare, however, of that portion of the sun seen through the slit rendered the observation futile. By projecting a large image of the sun into a darkened room, I was enabled to get the whole of the spectrum produced by the prismatic action of the atmosphere in a very satisfactory manner. In this case a semicircular diaphragm was used, so placed that its straight edge divided the field of view into equal parts, from one of which it obscured the light. The diaphragm was placed as before in the focus of the eyepiece, and by rotating it every portion of the sun's limb could be in turn examined, and that too in the centre of the field, so as to be equally subjected to the minimum of the peculiarities of the instrument. When the sun's lower limb was allowed to descend into the field of view the first rays were intensely red. After a momentary duration they gave place in succession to orange, yellow, and green, which were then lost in the ordinary refulgence of the sun. The upper limb gave green, blue, and finally purple, which latter colour I have thus far never seen upon the natural horizon. It should be remarked that the colours seen were vivid and unmistakable, and each one of them easily detained at will, or the whole phenomenon recalled, by the adjusting screws of the instrument. I apprehend that the results here given sufficiently prove that at mo spheric refraction is the cause of the coloured rays seen at the moment of the sun's departure below the horizon. I have, however, thought it worth while to examine the light proceeding from the moon's limb by the aid of the artificial horizon, and of course by direct observation. The results were decisive and satisfactory, the spectral colours being easily observed. The green effect I have also frequently seen on the departure of the moon beneath the edge of a dark and well-defined bank of clouds. Telescopic aid has, however, in every instance been required.

The rapid changes in colour observable in the case of almost any large fixed star at an elevation of twenty or thirty degrees above the horizon, and which changes vary between red, green, and blue, may I think be fairly attributed to the same cause as the colour in the sun's final ray. Particles of dust floating in the air act, I apprehend, for the moment, in the capacity of diaphragm or horizon, and thus enable the eye to perceive, even in the light of the stars, the prismatic action of our atmosphere.

Ordinary Meeting, October 21st, 1873.

EDWARD SCHUNCK, Ph.D., F.R.S., F.C.S., Vice-President, in the Chair.

W. BOYD DAWKINS, F.R.S, exhibited a fragment of a post struck by lightning, on 2nd June, 1873. It formed one of three, about 8 feet high and 15 feet apart, in the garden of 11, Norma Road, Rusholme, and stood under a cherry tree, of which the stem was 10 feet away. It was completely shattered, fragments being driven as far as the walls of the house, 25 yards off, and the downward direction of the loose splinters implied that the explosive force was exerted from below upwards, instead of from above downwards. People in the Dickenson Road observed what they termed a "thunderbolt" fall, as they thought, on the house, and some of the inhabitants describe it as a flame of light followed immediately by a crash of thunder. It is very probable that the explosion was produced by an electric current passing from the earth upwards, and not *vice versa*.

Professor REYNOLDS attributed the shattering of the post to the explosive or repulsive action of an electrical discharge of unusual intensity.

Mr. BAXENDELL thought it was most probably due to the sudden conversion of a portion of the moisture in the post into steam of high tension by the heating action of the electrical discharge, and mentioned instances in which condensed vapour was said to have been seen rising from trees immediately after they had been struck by lightning.

"*On the Relative Work spent in Friction in giving Rotation to Shot from Guns Rifled with an Increasing and a Uniform Twist*," by OSBORNE REYNOLDS, M.A., Professor of Engineering, Owens College, Manchester, and Fellow of Queens' College, Cambridge.

The object of this paper is to show that the friction between the studs and the grooves necessary to give rotation to the shot *consumes more work with an increasing than with a uniform twist*; and that in the case of grooves which develop into parabolas, such as those used in the Woolwich guns, the waste from this cause is double what it would be if the twist was uniform. This is important, for, although the magnitude of this waste does not appear as yet to have been the subject of direct inquiry, it will be seen that with the plane grooves it amounts to more than 1 per cent of the whole energy of the shot, and, consequently, with the parabolic grooves it will amount to 2 per cent of the energy of the shot; that is, to say the least, important as regards the effect of the discharge; and when we consider that all the work spent in friction is spent in destroying the gun and the shot, we see that it becomes a matter of the very greatest importance whether the gun spends 1 or 2 per cent of its power on self-destruction.

MR. BAXENDELL read the following extract from a letter he had received from the President:—"You will see that

I have put a little drying apparatus to the short limb on my syphon barometer. I believe that a long open tube attached to the short end by a bit of india-rubber tube will do just as well. This I am going to try, and also to exclude the air more perfectly than I find it is in the instrument at the Rooms. The principal fear was that the sulphuric acid would slowly act on the mercury. I think the barometer has been put up long enough to decide this, and I feel convinced that the plan will succeed.

NOTICES OF BOOKS.

Chemistianity (Popular Knowledge of Chemistry); a Poem: also an Oratorical Verse on each known Chemical Element in the Universe, giving Description, Properties, Sources, Preparation, and Chief Uses, arranged for Familiar or Memory Reading. By J. Carrington Sellars, F.C.S. Published by the Author (at his Office), Ferry Buildings, Birkenhead.

This is, without exception, the most remarkable book of the season. Its title—water-marked on every leaf,—its style, its terminology, its probable design, must alike puzzle the unfortunate critic, who in addition, finds himself defied in such passages as the following:—

"Waste-paper set-trap writers shall daunt me not;
The greased feather of my good intents
Shall repel their assafœtidal script
As freezing water from Muscovy duck."

In place of the "Muscovy duck," we fear that a more familiar bird may possibly be suggested to the mind of the reader.

The work consists of a "procemium," treating of a promiscuous assemblage of topics; a "prologue"; a description of the elements in oratorical verse, forming the main body of the book; and an appendix, containing a proposal for an entirely new system of chemical nomenclature. Novel terminology is, indeed, the author's *forte*. Thus, where chemists would speak of "chemical action" or "reaction," the Chemistian uses the word "goception," derived, as he kindly informs us, "from 'gang,' to pass, and 'præcipio,' to command." Then we have "floral" and "effloral" used as synonymes, respectively, for "mineral" and "organic." Copper is described as the "*siamatic* bond metal." Last, but not least, we instance "chemistianity" itself. Let us pause, however, before censuring the author for the use of such terms. If he has sinned, he is not alone. He may plead the example of men who, unable or unwilling to enrich science with new facts, new methods, or new generalisations, have earned fame, influence, and professorial chairs by the easier process of translating old doctrines into the terminology of the hour. If paradoxes and neologisms form the royal road to scientific eminence, it would be unfair to shut it against Mr. Sellars.

In the "procemium" the author exclaims:—

"Oh! would that the writers of systems
Themselves would write in some approved system,
Express their facts and views in arid language,
With truth, similes, and impressiveness:
Then there would be less obscurity
And more learning, yielding hornpipe joys through Earth."

Let us make few selections to show the author's approved system:—

"Therefore a human being may be said to be on certain subjects—simple, knowledgeful, subearth-willed, high-witted or with godly lore endowed. One division of the condition of a moleculed being might (diffidently) be imagined as that of clarified godly lore."

Here is a portion of a Chemistian song:—

"Chemistian lore should be
Well known on land and sea
To sow the seed of chemistry,
So heigh, so ho, so hee.
Blart quacks will lose their say,
Labour have its due day,
Capital worked in equity,
So hee, so ho, so heigh.
Miss Basic Merit's foe,
Trade-fraud, we'll plunge in woe,
And urge Commercial Honesty,
So heigh, so hee, so ho."

We were not aware that Merit was "Basic" rather than acid, and that it, or rather she, was a young lady.

Elsewhere we read:—

"One toned word, like an old familiar tune,
Will suffice to cant-er a rhyming coon."
"Thus marl-peat labour youth, with practical wit,
Tongue him with a Factor's queries and quips."
"By invention of cheap Aqua Blaster,
Which, started, will explosively gocept
When gocepted under Wheeler Blowdome."

From these and similar specimens, which might be greatly multiplied, we are forced to own that, however valuable the truths which the author seeks to convey, his mode of expression is not the most felicitous. It would be interesting to put this volume into the hands of some intelligent person totally unacquainted with chemistry, and to observe what notion of the science he would obtain from its perusal.

The "Oratorical Verse" contains little which is not correct in fact; still it would be difficult to find any information here which is not given more clearly and intelligibly in works easy of access. Hence we fail to see the *raison d'etre* of the volume before us. Profit, we are bound to admit, cannot have been the author's motive for appearing in print. He may, possibly, be suffering from the effects of a certain book of which we have heard it said that, when the chemical student has done with it, he may hand it over to his sister or his sweetheart as a collection of crochet patterns.

Mr. Sellars concludes his work with a proposal for a system of "alphabetical composition names" for the chemical elements and "their mineral (floral) compounds." Hydrogen, for instance, is to be called "abgen," to be pronounced *abb*; water becomes DiAbBe; boracic acid is TriAbAmtriBe; chloride of barium is diEbKe. Surely this proposal will commend itself to a certain section of the "Chemistian" world!

MISCELLANEOUS.

Iron in Tea.—Mr. Alfred Bird, of Worcester Street, sends a letter to the *Birmingham Daily Post* on this subject. He says—"In your report of yesterday's proceedings at the Police Court you make me say that 'the magnetic oxide was natural to tea.' What I said was 'that the magnetic oxide of iron exists naturally in the soil in which the tea plant grows,' in proof of which I stated that I had separated from the magnetic oxide of iron (found in the tea) particles of mica and quartz, the inference being 'that, as magnetic oxide of iron forms part of the soil of China, it would rise with the dust of the country, and, coming in contact with the damp leaves, would adhere to them when they are dried, and thus make the dried tea leaves stick to the magnet as if there were iron-filings mixed up amongst them.' I also stated that, not having any of the actual soil of China to examine for magnetic oxide of iron, it occurred to me to try if the dried leaves of plants grown in this country would be attracted by the magnet. Accordingly, I dried 100 grains of French bean leaves, grown in my own garden in the Bristol Road, and, to my great surprise, I found that particles of the leaves were attracted by the magnet, exactly like tea leaves. Now, as it was too absurd to suppose that the French bean leaves had iron-filings sticking to them, I carefully separated the broken leaves from the substance to which they adhered, and found that it was magnetic oxide of iron, the quantity in 100 grains of the bean leaves being 0·2 of a grain. The question then arose, 'Where did the magnetic oxide of iron come from?' To answer this, I dried a few ounces of the black mould of the garden, and, having searched it with the magnet, I attracted out abundance of the magnetic oxide of iron."

THE CHEMICAL NEWS.

VOL. XXVIII. No. 730.

PRELIMINARY INVESTIGATION OF THE FLUORESCENT AND ABSORPTIVE SPECTRA OF THE URANIUM SALTS.*

By HENRY MORTON, Ph.D.,
and H. CARRINGTON BOLTON Ph.D,

(Continued from p. 246).

Uranic Phosphates.

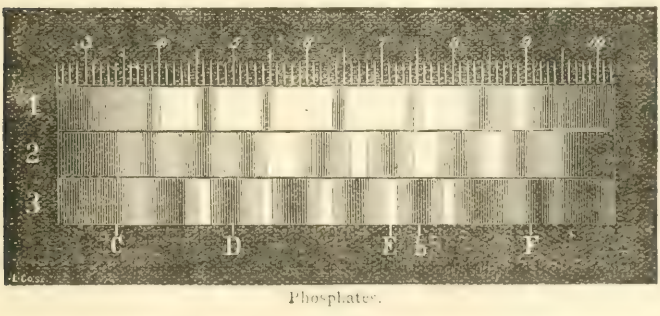
THE salts of this class which we have examined are the following:—

Mono-uranic phosphate,	$U_2O_3.2HOPO_5+3HO$
Di-uranic phosphate,	$2(U_2O_3).HO.PO_5+3HO$
Di-uranic phosphate hexahydrate,	$2(U_2O_3)HOPO_5+6HO$
Di-uranic phosphate octohydrate,	$2(U_2O_3)HOPO_5+8HO$
Uranic pyrophosphate,	$2(U_2O_3)PO_5$
Calcio-uranic phosphate,	$CaO.2(U_2O_3)PO_5+8HO$
Cupro-uranic phosphate,	$CuO.2(U_2O_3)PO_5+8HO$

The phosphates, like the arseniates, show a remarkable fixity of spectrum, so that, with the exception of the first, all these compounds show the same spectrum of fluorescence. With regard to their absorptive action, a little more variation is manifested.

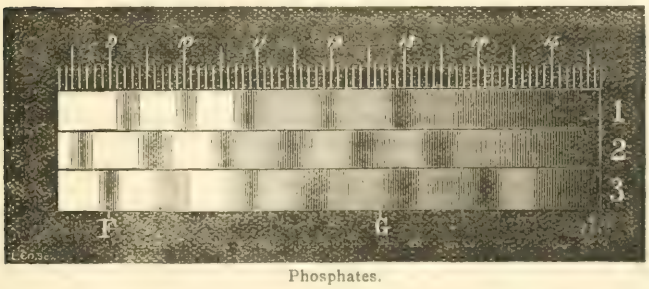
Mono-Uranic Phosphate, $U_2O_3.2HO.PO_5+3HO$.—This salt was formed by dissolving uranic hydrate in glacial phosphoric acid. The solution was evaporated in a desiccator until it attained a gelatinous consistency; in this state it remained for weeks without crystallising. A portion was then transferred to a small specimen-bottle for examination, when it soon began to crystallise in an almost solid mass. Crystallisation also began in the larger quantity, where it had been disturbed, and soon (in a few days) pervaded it also. The material thus formed was opaque, of a rich green colour, and very billiant fluorescence. Its spectrum, shown at 1 of Fig. 15, consisted of very broad bands, leaving only narrow dark spaces between them. The material in its gelatinous state, and also the dilute solution, fluoresced, and gave a spectrum in which all the bands were displaced downwards in the spectrum, and are more rounded in character; this spectrum is shown at 2 of Fig. 15. The absorption spectra in these two cases are also well marked, and are given in Fig. 16—1 being that of the solid salt, and 2 of the solution. Both salt and solution held an excess of phosphoric acid.

FIG. 15.



Phosphates.

FIG. 16.



Phosphates.

The various di-uranic and double phosphates already named yield the same fluorescent spectrum, with no difference but a variation in brightness, and this spectrum is shown at 3 of Fig. 15. It so happened that the first specimen examined was one of di-uranic phosphate prepared in the usual way, which gave a double spectrum, as shown at 8 of Fig. 1. Of this, the upper and fainter series of bands corresponds with the above general di-uranic spectrum, while the other, which disappears on drying, no doubt belongs to some hydrate which we have as yet been unable to identify.

The absorption spectra of these salts present a considerable variety of forms. That of the mixed hydrates just mentioned is shown in 8 of Fig. 1, that of the calcio salt at 9 of the same figure, and that of the di-uranic phosphate at 3 of Fig. 16. We have obtained others, but have not yet determined the hydration of the specimens yielding them. It seems likely that these may afford a means of distinguishing some of these salts where their fluorescent spectra are identical.

Sulphates.

The general rule, that bases of the formula U_2O_3 require 3 equivalents of a monobasic acid to form neutral salts, is conspicuously violated by the element uranium, and it was this peculiarity in the constitution of uranium salts which prompted Peligot's assumption of the so-called uranyl theory; thus, neutral uranic sulphate has the composition $U_2O_3SO_3+3HO$, or, according to Péligot, $(U_2O_2)OSO_3+3HO$. This salt is easily obtained by acting on uranic nitrate with concentrated sulphuric acid, or by treating uranic oxide with strong sulphuric acid, and in either case expelling the excess of acid by raising the temperature to about 300° C. The mass is then dissolved in water, and the solution evaporated to the consistency of a syrup; after standing for some time, small lemon-yellow crystals form, which may easily be separated from the mother-liquid. As thus obtained, the salt, according to the best authorities, contains 3 equivalents of water, 2 molecules of which are driven off in a current of dry air at 100° C., but the third molecule is given up only on heating to about 300° C. In this anhydrous state, the great affinity of the sulphate for water is noticeable; each drop as it strikes the mass hisses, and is converted into steam. On dissolving the neutral salt in strong sulphuric acid, and crystallising by spontaneous evaporation, an acid salt, $U_2O_3SO_3+HOSO_3$, is obtained. This uranic disulphate forms small needles grouped in warty concretions, and is of a much greener hue than the neutral sulphate. As will appear below, the spectrum of the salt is quite different from that of the neutral one.

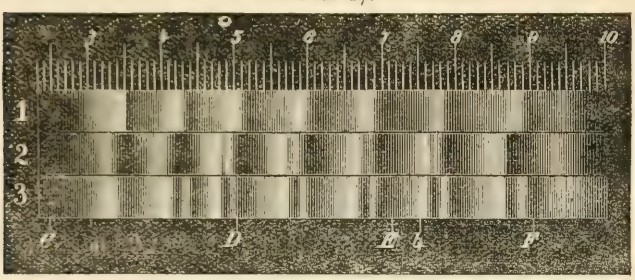
A trisulphate is described by Berzelius, but its existence is denied by Péligot. Its formula, according to the uranyl theory, would be $(U_2O_2)O_3SO_3$, which is highly improbable. At present writing, attempts to obtain a trisulphate with a definite spectrum have been unsuccessful

* Communicated by President Morton.

Ordway (*Am. Journ. Sci.*, [2], xxvi., 208, 1858) obtained a tribasic sulphate, $3U_2O_3.SO_3$, by treating a solution of the normal salt with baric carbonate; this compound, as well as the minerals johannite, zipperite, uranochalcite, medjidite, voghanite, and uraconite (Dana)—different varieties of hydrous uranic sulphate,—have not as yet been examined.

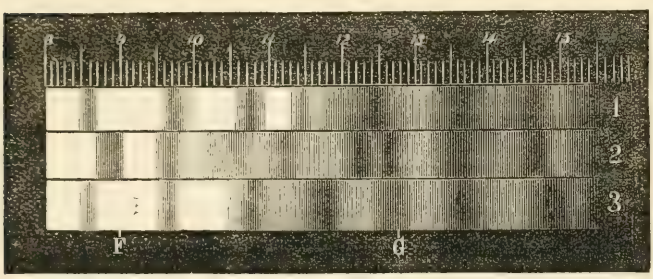
The optical study of the uranic sulphate was attended at the outset by great difficulties, arising from the fact that, after several specimens had been studied which gave the same spectrum—that, namely, shown at 1 of Fig. 17,—others, prepared under what were supposed to be identical conditions, showed such spectra as from previous experience we had reason to believe indicated the existence of a mixture (see 3, Fig. 17). After seeking in vain for any impurity, it became at last evident that these mixed spectra resulted from the presence of the salt in two states of hydration, which depended upon very slight variations in their mode of crystallisation and subsequent exposure. It

FIG. 17.



Uranic Sulphate.

FIG. 18.



Uranic Sulphates.

required, however, a long course of experiments to develop these facts, and to fix even some of these conditions, and others yet await further investigations.

To put the matter in its most concise shape, we will here briefly state the results so far obtained. When the uranic sulphate crystallises from a cold solution by evaporation in the air, or sometimes by cooling from a hot solution, it takes up 3 atoms of water, and yields the spectrum shown at 1, Fig. 17, which may be regarded as its normal spectrum. The presence of a moderate excess of acid does not seem to effect this, though it has a decided influence on the subsequent behaviour of the salt.

If this salt is exposed to the air until adherent moisture has been carried off, and is then slowly dried, at first below and then at 100° C., it will lose 2 atoms of water and pass to the condition of the mono-hydrated salt. It then yields such a spectrum as is shown at 2 of Fig 17. If, however, the drying is carried on rapidly, as, for example, by placing the moist salt in a hot-water oven already at 100° C., evaporating the solution nearly to dryness on the water-bath, or occasionally even by drying over sulphuric acid, an amount of water is lost varying between 4·9 per cent and 5·7 per cent, and a double spectrum is developed, in which one set of bands seems to correspond with those of the mono-hydrate, and the other set to be unlike those of the normal salt (see 3 of Fig 17).

We have as yet been unable to isolate the substance giving these bands, but we have no doubt that they belong to the bihydrate of the uranic sulphate. By continuing to heat the substance in which this double spectrum has been developed we can reduce the strength of the bands belonging to this unisolated substance, and relatively strengthen those of the other, a small amount of water being at the same time expelled; but we cannot apparently reduce the mixture to the condition of the mono-hydrate alone. Thus a sample which had lost 5·7 by being heated suddenly to 100°, and refused to lose more at that temperature, by heating to 150° C. lost 0·5 per cent more, and then maintained a constant weight. The spectrum in both cases being of the same duplex character, and differing only in the relative strength of the two sets of bands.

If this same salt in a normal state is placed suddenly in an oven at 150° it will lose about 8·7 per cent of water, but will again still show the same double spectrum, but with a loss of brilliancy in fluorescence. It therefore seems highly probable that in this case the salt has in part been reduced to an anhydrous condition in which it has no fluorescence.

The formation of certain of these hydrates seems to depend upon the combined action of heat and moisture due to the suddenness of the heat, which in driving out the water from part of the salt bathes another part in its hot vapour. We have made some experiments in the direction which this suggests, but as yet without reaching a decided result. There are, however, some analogous cases to which we would call attention. Thus the blue hydrate of cupric oxide changes to black anhydrate by a heat of 100° when diffused in water; so the ferric hydrate. Again, a solution of $ClO.SO_3+3HO$ yields, on heating, crystalline flakes of $2(ClOSO_3+3HO$, or abandons half its water. From what has been done, however, we think that we may, without risk of error, assume that the neutral uranic sulphate forms three hydrates with one, two, and three equivalents of water respectively, and that each of these has a distinct and characteristic spectrum.

The uranic disulphate gives a spectrum in which the bands are much less defined than are those of the normal salt, and are also less unlike in the abruptness with which they shade off on their upper and lower edges. The positions of their centres or brightest parts are given in the following table:—

Spectrum of Uranic Disulphate.

Bands.	1.	2.	3.	4.	5.	6.	7.	8.
	33·2	40·8	48·4	57·6	66·8	76·4	86·0	94·0

If this salt is dried over sulphuric acid it has its fluorescence somewhat reduced, and the position of its bands is elevated in the spectrum, as the following table will show:—

Spectrum of Dried Uranic Disulphate.

Bands.	1.	2.	3.	4.	5.	6.	7.	8.
	33·2	41·2	49·2	58·5	68·0	78·0	87·6	96·8

In solution the above-mentioned salts fluoresce with moderate brightness, and give banded spectra, the position of whose lines does not seem to differ from that of the solid salt. If a solution is made in strong sulphuric acid the fluorescence is very bright, but the position of the bands seems to be unchanged. In these solutions, however, the bands are in all cases less defined than in the solids.

The absorption-bands of the neutral and acid sulphates are shown in 1 and 2 of Fig. 18 respectively, and in 3 we find the bands of the solution of either of these, or, indeed, of any other uranic sulphate which we have yet examined.

It would seem with the sulphates, as with the acetates, that all are reduced to the same condition when in solution, and that this condition seems to be that of the neutral acetate. There is, however, this decided want of parallelism in the two cases, that, whereas an excess of acetic acid is necessary to bring out the spectrum of the acetates, an excess of sulphuric acid seems to have no effect. The fluorescence, also, of these solutions is unaffected by an excess of acid, or, rather, is very much brighter where pure sulphuric acid is the solvent than in the aqueous solution.

(To be continued).

"IRON FILINGS" IN TEA.

By W. MATTIEU WILLIAMS, F.C.S.

I HAVE watched the progress of the tea controversy and the other public performances of the public analysts with considerable interest; it might have been with amusement, but for the melancholy degradation of chemical science which they involve. Among the absurdities and exaggerations which for some years past have been so industrially trumpeted forth by the pseudo-chemists who trade upon the adulteration panic and consequent demand for chemical certificates of purity, the continually repeated statements concerning the use of iron filings as a fraudulent adulterant of tea takes a prominent place.

I need scarcely remark that, in order to form such an adulterant, the quantity added must be sufficiently great to render its addition commercially profitable to an extent commensurate with the trouble involved. Now the gentlemen who, since the passing of the Adulteration Act, have by some kind of inspiration suddenly become full-blown chemists, have certified to wilful adulteration of tea with iron filings, and have obtained *convictions* on such certificates, when, according to their own statement, the quantity contained has not exceeded *five per cent* in the cheapest qualities of tea. Now the price of such tea to the Chinaman tea-grower, who is supposed to add these iron filings, is about fourpence to sixpence per pound; and we are asked to believe that he will fradulently deteriorate the market value of his commodity for the sake of this additional 1-20th of weight. Supposing that he could obtain his iron filings at twopence per pound, his total gain would thus be about 1-10th of a penny per lb.

But can he obtain such iron filings in the quantity required at such a price? A little reflection or a few figures will render it evident that he cannot, and that such adulteration is utterly impossible.

I find, by reference to the *Grocer* of November 8th, that the total deliveries of tea in the Port of London during the first ten months of 1872 was 142,429,337 lbs., and during the corresponding period of 1873 139,092,409 lbs. Of this, about 8½ millions of pounds in 1873, and 10 millions of pounds in 1872, were green, the rest black. This gives, in round numbers, about 160 millions of pounds of black tea per annum, of which above 140 millions come from China. As the Russians are greater tea drinkers than ourselves—the Americans and British colonists are at least equally addicted to the beverage, and other nations consume some quantity—the total exports from China may be safely estimated to reach 400 or 500 millions of pounds. Let us take the smaller figure, and, adopting the more moderate statements of the adulteration panic mongers, suppose that only one-fourth of this is adulterated, to the extent of 5 per cent, with iron filings. How much will be required? Just 5 millions of pounds per annum. Now it must be remembered the *coarse* filings could not possibly be used; they would show themselves at once to the naked eye as rusty lumps, and would shake down to the bottom of the chest; neither could borings, nor turnings, nor plane-shavings be used. Nothing but *fine* filings will answer the supposed purpose. I venture to assert that if the China tea-growers were to put the whole world under contribution for their supposed supply of fine iron filings, this quantity could not be obtained. Let anyone who doubts this borrow a blacksmith's vice, a fine file, and a piece of soft-iron, then take off his coat and try how much labour will be required to produce a single ounce of filings, and also bear in mind that fine files are but very little used in the manufacture of iron. As the price of a commodity rises when the demand exceeds the supply, the Chinaman would have to pay far more for his adulterant than for the leaves to be adulterated. As Chinese tea-growers are not public analysts, we have no right to suppose that they would perpetrate any such foolishness.

The investigations recently made by Mr. Alfred Bird, of Birmingham, show that the iron found in tea leaves is not in the metallic state, but in the condition of oxide, and he confirms the conclusions of Zöller, quoted by Mr. J. A. Wanklyn in the CHEMICAL NEWS, of October 10, viz., that compounds of iron naturally exist in genuine tea.

It appears, however, that the ash of many samples of *black* tea contains more iron than naturally belongs to the plant, and accepting Mr. Bird's statement that this exists in the leaf as oxide mixed with small siliceous and micaceous particles, I think we may find a reasonable explanation of its presence without adopting the puerile theory of the adulteration maniac, who in his endeavour to prove that everybody who buys or sells anything is a swindler has at once assumed the impossible addition of iron filings as a make-weight.

In the first place we must remember that the commodity in demand is *black* tea, and that ordinary leaves dried in an ordinary manner are not black but brown. Tea leaves, however, contain a large quantity of tannin, a portion of which is, when heated in the leaves, readily convertible into gallo-tannic or tannic acid. Thus a sample of tea rich in iron would, when heated in the drying process, become by the combination of this tannic acid with the iron it contains, much darker than ordinary leaves or than other teas grown upon less ferruginous soils, and containing less iron.

This being the case, and a commercial demand for *black* tea having become established, the tea grower would naturally seek to improve the colour of his tea, especially of those samples naturally poor in iron, and a ready mode of doing this is offered by stirring in among the leaves while drying a small additional dose of oxide of iron, if he can find an oxide in such a form that it will spread over the surface of the leaf as a thin film. Now it happens that the Chinaman has lying under his feet an abundance of material admirably adapted for this purpose, viz., red hæmatite, some varieties of which are as soft and unctuous as graphite, and will spread over his tea leaves exactly in the manner required. The micaceous and siliceous particles found by Mr. Bird are just what should be found in addition to oxide of iron, if such hæmatite were used.

The film of oxide thus easily applied and subjected to the action of the exuding and decomposing extractive matter of the heated leaves would form the desired black dye or "facing."

The knotty question of whether this is or is not an adulteration is one that I leave to lawyers to decide, or for those debating societies that discuss such interesting questions as whether an umbrella is an article of dress. If it is an adulteration, and as already admitted, is not at all injurious to health, then all other operations of dyeing are also adulterations, for the other dyers, like the Chinaman, add certain impurities to the silk, wool, or cotton, in order to alter their natural appearance, and give them the false facing which their customers demand, but with this difference, if I am right in the above explanation, that in darkening tea nothing more is done but to increase the proportion of one of its natural ingredients, and to intensify its natural colour, while in the dyeing of silk, cotton, or wool, ingredients are added which are quite foreign and unnatural, and the natural colour of the substance is altogether falsified.

ON THE

ACTION OF BROMINE ON THE WATER-SALTS OF SUCCINIC, MALIC, MALEIC, AND PYRO-CITRIC ACIDS,

CRITICALLY EXAMINED AND INTERPRETED FROM THE STANDPOINT OF THE "TYPO-NUCLEUS" THEORY.

By OTTO RICHTER, Ph.D.

(Concluded from p. 248).

PART II.

On the Principal Molecular Changes that attend the Action of Bromine on the Water-Salts of Pyro-Citric Acid.

WHEN the three isomeric modifications of pyro-citrate of water aretreated with bromine, the resulting dibrominated meta water-salts are expressed by the collective formula—

$$\gamma)\quad 2HC_6Br;\qquad \overline{H_2O_2.\qquad H_2O_2.}$$
$$\alpha)\quad 2(HC_2Br:C_2:C_2)\,;\,\overline{H_2Br_2\,;\,2H\,;\,2C_2O_3\sim 2H\,;\,2C_2O_3}.$$
$$\beta)\quad 2(HC_4Br:C_2)\,;$$

In this process the bromine is understood to act in accordance with the second method, so that the first stage will be marked by the direct union of 2 mols. of bromine with the complex carbon adjunct.

In the next stage 2 mols. of water suffer decomposition, their oxygen serving to oxidise the formous acid principal, while their hydrogen, by reacting upon the dibrominated carbon adjunct, gives rise to a molecule of hydrobromic acid, which, by transposing with the colligated alcohol, completes the formation of the new compound.

The reader, by taking his cue from the behaviour of the ortho-succinate under similar circumstances, will not be slow to perceive that the dibrominated derivative of the ortho-pyro-tartrate, which is the next upper homologue of the succinate, ought to be expressed by the formula—

$$\overline{H_2O_2.\qquad H_2O_2.}$$
$$\alpha)\quad \overline{2(H_2C_2:C_2)\,;\,H_2Br_2\sim 2C_2\,;\,H_2Br_2\,;\,2C_2O_3\sim 2C_2O_3}\,;$$
$$\beta)\quad 2H_2C_4\,;$$

but although Lagermann and others have tried to obtain this compound by the usual method, they do not seem to have arrived at satisfactory results.

In connection with this subject a singular fact has been brought to light, which is, that under the influence of sodium amalgam these three varieties of meta-dibromo-pyro-tartrate agree with their parent molecules, the three varieties of pyro-citrate, in producing but a single variety of ortho-pyro-tartrate, instead of the three which are indicated by theory. In order to account for this discrepancy, I proceed upon the hypothesis that the three varieties of meta-pyro-tartrate are actually formed at the commencement, but that in the existing conditions they are speedily made to merge into the β variety of the ortho-pyro-tartrate.

It is meet that I should now advert to a very interesting series of transformations which certain descendants of the three varieties of meta-dibromo-pyro-tartrate are apt to experience under the influence of certain chemical reagents. When the salts of these three varieties are boiled with water, carbonic acid is given off, and two varieties of dibromo-butyrate are left behind. Their formula—

$$\overline{H_2O_2.}$$
$$\alpha)\quad \overline{2(H_2C_2:C_2)\,;\,H_2Br_2\sim 2C_2\,;\,H_2Br_2\,;\,2H\,;\,2C_2O_3},$$
$$\beta)\quad 2H_2C_4\,;$$

is based upon the following train of reasoning:—

In the first stage, 2 mols. of water yield up their oxygen to the formic acid ally; while their hydrogen, by reacting upon the bromo-hydrocarbon adjunct, gives rise to a molecule of hydrobromic acid, whose immediate union with a molecule of formen, &c., completes the formation of the compound—

$$\overline{H_2O_2.\qquad H_2O_2.}$$
$$\alpha)\quad \overline{2(H_2C_2:C_2)\,;\,H_2Br_2\sim 2C_2\,;\,H_2Br_2\,;\,2H\,;\,2C_2O_3\sim 2H\,;\,2C_2O_5}.$$
$$\beta)\quad 2H_2C_4\,;$$

This meta water-salt soon resolves itself, in the next stage, into 2 mols. of water which are liberated, and the ortho water-salt—

$$\overline{H_2O_2.\qquad H_2O_2.}$$
$$\alpha)\quad \overline{2(H_2C_2:C_2)\,;\,H_2Br_2\sim 2C_2\,;\,H_2Br_2\,;\,2C_2O_3\sim 2C_2O_3},$$
$$\beta)\quad 2H_2C_4\,;$$

which, by the loss of 2 mols. of carbonic acid, becomes finally converted into the dibromo-butyrate, as formulated above.

It is at this point that the interesting series of metamorphoses commences, to which allusion has just been made, but for the proper comprehension of which I require to submit first of all the analysis of a kindred and more familiar, but as yet perfectly unintelligible, series of reactions. The case selected for illustration and comparison refers to the characteristic deportment of the dibromide of ethylen on its being subjected to the alternate influence of hydrate of potash and bromine. Now the molecular changes attending the successive stages of this curious reaction may be described as follows:—

In the first stage, the dibromide of ethylen—

$$\overline{2H_2C_2\,;\,H_2Br_2\sim 2C_2\,;\,H_2Br_2}$$

transposes with the hydrate of potash, with production of the compound—

$$\overline{H_2O_2.}$$
$$\overline{2H_2C_2\,;\,H_2Br_2\sim 2C_2\,;\,H_2O_2},$$

and bromide of potassium, under the influence of which the former molecule is speedily made to resolve itself into 2 mols. of water and the body—

$$2(H_2C_2:C_2)\,;\,H_2Br_2.$$
$$2H_2C_4\,;$$

In contact with 2 mols. of bromine, this latter becomes then changed into the compound—

$$2HC_2Br\,;\,H_2Br_2\sim 2C_2\,;\,H_2Br_2,$$

which, with the aid of a second molecule of hydrate of potash, becomes quickly reduced to the body—

$$2(HC_2Br:C_2)\,;\,H_2Br_2.$$
$$2HC_4Br$$

SYNOPTICAL ARRANGEMENT OF CHEMICAL FORMULÆ, COMPRISING THE BROMINATED DERIVATIVES OBTAINED BY THE ALTERNATE ACTION OF HYDRATE OF POTASH AND BROMINE ON THE DIBROMO-BUTYRATE OF WATER.

Dibromo-butyrate—

$$\overline{H_2O_2.}$$
$$\alpha)\quad \overline{2(H_2C_2:C_2)\,;\,H_2Br_2\sim 2C_2\,;\,H_2Br_2\,;\,2H\,;\,2C_2O_3}.$$
$$\beta)\quad 2H_2C_4\,;$$

Tribromo-butyrate—

$$\overline{H_2O_2.}$$
$$\alpha)\quad \overline{2(HC_2Br:C_2)\,;\,H_2Br_2\sim 2C_2\,;\,H_2Br_2\,;\,2H\,;\,2C_2O_3}.$$
$$\beta)\quad 2HC_4Br\,;$$

Tetrabromo-butyrate—

$$\overline{H_2O_2.}$$
$$\alpha)\quad \overline{2(C_2Br_2:C_2)\,;\,H_2Br_2\sim 2C_2\,;\,H_2Br_2\,;\,2H\,;\,2C_2O_3}.$$
$$\beta)\quad 2C_4Br_2\,;$$

Bromo-crotonate—

$$\gamma)\quad 2H_2C_6\,;\qquad \overline{H_2O_2.}$$
$$\alpha)\quad 2(H_2C_2:C_2:C_2)\,;\,\overline{H_2Br_2\,;\,2H\,;\,2C_2O_3}.$$
$$\beta)\quad 2(H_2C_4:C_2)\,;$$

Dibromo-crotonate—

$$\gamma)\quad 2HC_6Br\,;\qquad \overline{H_2O_2.}$$
$$\alpha)\quad 2(HC_2Br:C_2:C_2)\,;\,\overline{H_2Br_2\,;\,2H\,;\,2C_2O_3}.$$
$$\beta)\quad 2(HC_4Br:C_2)\,;$$

Tribromo-crotonate—

$$\gamma)\quad 2C_6Br_2\,;\qquad \overline{H_2O_2.}$$
$$\alpha)\quad 2(C_2Br_2:C_2:C_2)\,;\,\overline{H_2Br_2\,;\,2H\,;\,2C_2O_3}.$$
$$\beta)\quad 2(C_4Br_2:C_2)\,;$$

In contact with a second pair of bromine molecules, this latter becomes then changed into the compound—

$$2C_2Br_2 ; H_2Br_2 - 2C_2 ; H_2Br_2,$$

which, with the aid of a third molecule of hydrate of potash becomes finally transformed into the body—

$$\begin{matrix} 2C_2Br_2 ; C_2 ; H_2Br_2. \\ 2C_4Br_2 ; \end{matrix}$$

By applying the preceding train of reasoning to the dibromide of allylen, which in the dibromo-butyrate is made to play the part of a halogen adjunct, the reader will not find it difficult to interpret the molecular changes which ensue on the dibromo-butyrate being subjected to a similar treatment. It will, therefore, suffice to append a list of the chief transition products with which, in the absence of the customary winding up, this paper is perhaps rather abruptly brought to a close.

ANALYSIS OF CIGAR ASH (HAVANNAH).

By A. PERCY SMITH, F.C.S.

Potash sulphate	7·401
Potash carbonate	9·012
Soda chloride	3·272
Soda carbonate	1·039
Calcium sulphate	4·180
Calcium carbonate	45·400
Ferric oxide and phosphate	0·460
Calcium and magnesia phosphates	9·210
Silica	9·641
Carbon	3·162
Traces of alumina and lithia carbonate, and loss, &c.	1·459
	100·000

PROCEEDINGS OF SOCIETIES.

GLASGOW PHILOSOPHICAL SOCIETY.

(CHEMICAL SECTION).

THE first meeting of the session of the Chemical Section of the Philosophical Society of Glasgow was held on the evening of Monday, November 10th, when Dr. William Wallace, F.R.S.E., delivered the opening address as retiring President.

After a few introductory remarks, Dr. Wallace spoke with some detail on the operation of the Adulteration Act, and the difficulties attending it so that convictions might be obtained in accordance with its spirit. He specially referred to milk and tea among the articles of food that are subjected to adulteration. The only cure for the anomaly of retailers of tea being subjected to the hardship of being severely fined for selling adulterated tea, though they were perfectly innocent of the fact that it was adulterated, would be to have each cargo of tea, as it arrives at port, examined by Government officials, who should have power to order the destruction of all tea which had been mixed with adventitious matter. Dr. Wallace considered that there could be no doubt that the Adulteration Act would greatly increase the number of professional chemists in this country. Already some of the gentlemen appointed as Analysts had exercised their vocation, not only in testing the samples submitted to them, but also in adding important facts to our knowledge regarding certain articles of food. He strongly urged the desirability of appointing, as Analysts under the Act, competent and experienced chemists having reputations to support, and making it worth their while to give attention to their duties, by giving them fixed incomes in addition to moderate fees.

The prevention of smoke next received some notice from Dr. Wallace, and the operation of the law relating to that subject was shown to be somewhat anomalous in Glasgow, inasmuch as a person might erect a hundred puddling furnaces within the city, which might give off dense volumes of the blackest smoke day and night, without the owner being interfered with, for the law could not touch him; but if the thousandth part of the smoke were emitted from a badly-fixed boiler, the myrmidons of the law would pounce upon the owner at once.

Dr. Wallace dwelt at considerable length upon the chemical questions involved in the disposal of the sewage of large towns, and the conservation of the purity of rivers. There was probably no great town or city in the three kingdoms where the whole question of the disposal of the sewage had been so thoroughly discussed, or so perfectly understood, as in Glasgow, and there was perhaps none in which so little had been done. The local sewage literature was of great extent and value, but the citizens had hitherto been content to look on and witness the experiments conducted elsewhere, sometimes at enormous expense, and the failures that had almost invariably attended the experiments. There were local gentlemen, high in office, who were in favour of the great Bateman and Bazalgette scheme of pumping and conveying the Glasgow sewage to the sands on the Ayrshire coast, for the purpose of irrigation, at a cost of something like £2,000,000; but he sincerely hoped that those gentlemen would study the subject further, and see for themselves the results of sewage irrigation elsewhere. For the Glasgow sewage an area of 25,000 acres, or nearly forty square miles, would be required for the Glasgow sewage if irrigation were to be resorted to.

After speaking of the various systems of sewage filtration and so-called purification—General Scott's, the A B C, and that by the use of peat charcoal, as practised at Bradford—Dr. Wallace said that a revised Pollution of Rivers Act would doubtless be passed next session, and that not unlikely it would be made applicable to Scotland as well as to England, in which manufacturers would be brought under a very stringent law; but, as long as the water-closet sewage was discharged into rivers, it would be ridiculous to impose penalties upon manufacturers for adding their comparatively trifling contribution of polluting ingredients. Dr. Wallace concluded his address by making some very practical remarks regarding the endowment of scientific research, a subject to which renewed interest had been imparted by the address of Professor Williamson as President of the British Association at its recent meeting at Bradford. He said it was disgraceful that in Glasgow, a city which owed so much of her wealth to chemical manufactures, there was no professor of technology, and that even the chair of chemistry was so miserably endowed that its occupant—one of the ablest and most industrious of modern chemists—was obliged to eke out the means of subsistence by commercial work which, though important enough in itself, might be performed equally well by men of far inferior talent and originality.

Speaking of analytical work, he said that, in this country especially, it had become an important branch of the profession, and that it had of late years attained a scientific precision which it never before possessed. It was not uncommon for analyses to be made for commercial purposes, and for a comparatively trifling fee, with greater skill and a higher degree of accuracy than was exhibited in a large proportion of the researches published in scientific journals; and it often happened that a chemist brought up in what might be called a strictly scientific laboratory was totally incapable of undertaking the simplest analyses with results that were of any practical use. Such knowledge, like every other kind that was valuable, was only to be acquired by hard work and great practice, but that fact made it impossible for an analyst having a large and engrossing business to devote any portion of his time or talents to the higher branches of chemical study. Other sub-divisions of chemical science led to the

same exclusiveness of thought and narrowing of observation and it was just to prevent the evil results that would naturally follow that a Society such as the Chemical Section was valuable in bringing together men who studied different branches of the science, and enabled them to communicate their ideas and knowledge to the mutual benefit of all.

The address was listened to most attentively and heartily applauded, and at its conclusion, on the motion of Mr. Mayer, seconded by Mr. John Jex Lang, a cordial vote of thanks was passed to Dr. Wallace. A hope was also expressed that the address would as soon as possible be published *in extenso* in the *Proceedings* of the Philosophical Society.

CORRESPONDENCE.

PUBLIC ANALYSTS.

To the Editor of the Chemical News.

Sir,—Every *chemist* will be pleased with your remarks upon the way in which the Adulteration of Food Act is being carried into law. I think that it is high time that something be done to stop the sliding of the post of public analyst into unqualified hands. So far as the appointments of analysts have as yet proceeded, they have either fallen upon one lucky individual, or relapsed into the possession of a complete tyro. It is stated that Professor Gardner, of the Polytechnic, is unable to "qualitatively" detect alum in bread for a fee of 10s. 6d., but he can do so "quantitatively" for 5 guineas. I allude to the Shoreditch case. Will "the learned Professor" kindly explain? He has given his share towards the impression that there ought to be a "Society for the Protection of Tradesmen from Analysts."—I am, &c.,

Os.

[We shall probably give an article in our next issue on the detection of alum in bread.—Ed. *C. N.*].

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, October 13, 1873.

Purifier for Coal-Gas, Capable of Serving at the Same Time for Mixing Gases with the Vapours of Liquids.—M. D. Colladon.—Gas requires to be freed from particles of solid matter, naphthalin, coal-tar, ammoniacal salts &c., as well as from gases such as carbonic and sulphurous acids. For washing it vessels have been employed similar to Woolf's bottle, in which the gas traverses water or a suitable solution through a metallic network in the form of bubbles or continuous currents. This arrangement is insufficient for working on a large scale; because the bubbles of gas take a spherical form, and consequently present a minimum of surface for a maximum volume. Further, this method requires a decided increase of pressure, which is inconvenient. Chemical "cascades," in which the gas passes upwards through a fine rain of the washing liquid, act much better, but require too large a quantity of liquid. Coke-towers (scrubbers) produce a more complete effect, but the action is irregular. The new mechanical washing apparatus has the advantage of producing very powerful action without requiring large dimensions. At Geneva it yields coal-gas, superior both in illuminating power, and in a sanitary point of view. Less purifying matter is also required than on the old system. The same apparatus will doubtless prove useful when it is required to saturate a gas with the vapours of a liquid, *e.g.*, hydrogen with the vapour for petroleum. The system rests on this principle, that the best arrangement either for washing a gas or for saturating it consists in making it strike, in the form of currents as thin as possible, against solid walls kept perpetually moist. The currents are broken against these surfaces, and are prevented from moving on in a straight line. The gaseous particles are thus always kept in a rotatory movement, and are pressed against the moist walls, so that they may either absorb the substance diffused over these walls or may deposit there a part of their own substance, according as it is required to saturate the gas or to wash it.

New Method of Tempering Steel, and Regeneration of Burnt Iron.—M. H. Caron.—A piece of steel is generally tempered, and then re-heated more or less according to the hardness and the elasticity which it requires to receive. The dry temper, as commonly practised, that is to say, the plunging the red-hot metal into cold water, has the drawback of developing cracks and crevices injurious to its tenacity. Re-heating does not remove these flaws; and subsequently on use these fissures, though invisible at first, increase and terminate in fractures. It has already been discovered that in order to escape from this danger it is preferable to temper the steel a little less hard, and afterwards to re-heat more slightly. The author has succeeded in producing the combined effects of tempering and re-heating in one operation, and of removing as far as possible the chances of flaws. This is done by heating the water into which the red-hot metal is plunged to 55°. Tempering in hot, or even boiling water, modifies soft steel containing two- to four-thousandths of carbon. This process augments its tenacity and elasticity without sensibly altering its softness. The texture is changed and becomes fibrous, even if previously crystalline. The author's method for restoring burnt metal is likewise to plunge it at a red heat into a hot liquid.

Use of Bisulphite of Potassa as Test for Galena in all its Mixtures.—M. E. Jannetaz.—It is sufficient to throw upon coarsely pounded galena a fragment of bisulphate of potash to produce a distinct evolution of sulphuretted hydrogen. If the two bodies are ground together the odour becomes almost insupportable. Bisulphate of potash, kept in fusion for half-an-hour, produces the same effect, perhaps with less intensity. Sulphuric acid, mixed or even heated with galena, does not give rise to a sensible disengagement of sulphuretted hydrogen. Blende gives a sulphydric odour, but less intense. Sulphides of antimony, iron, mercury, and silver give off no sensible odour. Boulangerite, zinkenite, bournomite, and, in general, the sulphides in which lead and sulphur do not form an isolated combination, do not yield their sulphur to the bisulphate of potassa.

On Crystalline Dissociation (Continued); Evaluation and Distribution of Work in Saline Solutions.—MM. Favre and Valson.—The authors here examine the coercitive effects produced by some thirty different salts on their solvents. The following are some of the chief results:—(1) All the salts examined, except chloride, bromide, and iodide of ammonium, give contraction. (2) Taking as measure of coercitive action the specific contraction represented by—

$$\frac{V - v}{V}$$

(where V is the volume of an equivalent of the salt

and v the increase of volume in the water) the salts, with regard to coercitive energy, may be thus grouped; first group, carbonates and borates; second, sulphates and fluorides; third, chlorides, acetates, and bromides; fourth, iodides. Comparing the metallic radicals we have this other arrangement:—first, aluminium and copper; second, strontium, barium, and calcium; third, sodium and potassium; fourth, ammonium. Sulphate of alumina and carbonate of soda gave the greatest contraction; iodide of ammonium gave the least. (3) In dissolving there are two opposite effects—contraction of the solvent and increase of volume of the salt; the former being generally greater than the latter. (4) The values of d (the densities of "normal," solutions in which an equivalent of the salt is dissolved in 1 litre of water) afford new evidence that each saline radical produces in the solution an increase of density, which is proper to it, and independent of, any other radical with which it may be associated. (5) The negative values of $V-v$ obtained for chloride, bromide, and iodide of ammonium, and the almost *nil* value of $V-v$ for nitrate of ammonium, seem to show that in salt solutions the ammonical salts are in a much more advanced state of dissociation than the other salts studied. The authors next offer some observations which seem to favour the supposition that the constituent elements of salts themselves may experience, in a certain measure, a phenomenon of dissociation more or less advanced, such as occurs, *e.g.*, in the passage of ordinary hydrogen to the state of active hydrogen. We may interpret the phenomenon of coercition by comparing with it the well-known phenomenon of the condensation of gases and liquids by solid bodies. Consider what occurs when CO_2 (for example) is condensed by charcoal. The gas, in condensing to the full, liberates a quantity of heat greater than that which it liberates in solidifying. Moreover, in condensing by successive fractions, the first fraction of gas liberates more heat than the second, the second more than the third, and so on to the last. So that, under the coercitive influence of charcoal, the carbonic acid seems to form layers of decreasing density (starting from the surface of condensation). Something very similar probably occurs when a salt is in the presence of water; the molecular surfaces of the solid, brought to a state of extreme division, acting on the water, and giving it a density superior to that which it has in the liquid state, and even in the solid state.

Researches on the Ancient Fauna of the Island of Rodrigues.—M. Alph. Milne-Edwards.—This island, about three hundred miles E.N.E. from Mauritius, had in the 17th century a rich vegetation and varied fauna; but the animals have almost entirely disappeared, in consequence, direct or indirect, of the destruction of the woods by burning.

Verification of Huyghens's Law of Double Refraction by the Prism Method.—Extract from memoir by M. Abria.—Suppose a bi-refringent surface in the form of a prism presenting five diedral angles; the axis having a certain direction. If one measures for a particular line, D for example, the index of refraction of each of the rays, bringing the prism into the position of minimum of deviation for the rays, one should find a constant value of the index for one of them, which will be the ordinary ray, and will thus be determined. The prism being in the position of minimum deviation, for the ordinary image, if one measures the angle which the emergent rays form, ordinary and extraordinary, in their exit from the prism; this may then be compared with the result obtained by Huyghens's law. If there is agreement no doubt can remain as to the correctness of this law. The author gives, in a table, the result of eighteen experiments; ten with a prism of spar, and eight with two quartz prisms. The differences are nearly always under $\frac{1}{100}$th of the quantity measured, thus confirming the law.

Researches on the Action of Substances Termed Antiseptic on Carbonaceous Virus.—M. Davaine.—(It was stated in a previous note that the virus was destroyed by a temperature varying between 48° and 55° C., according to the duration of application of the heat.) The antiseptic agents examined are arranged in the following order of power:—Ammonia, silicate of soda, ordinary vinegar and phenic acid, caustic potash, chloride of oxide of sodium, hydrochloric acid, permanganate of potash, chromic acid, sulphuric acid, iodine. The power of ammonia, vinegar, and phenic acid being represented by $\frac{1}{200}$, that of iodine will be represented by $\frac{1}{12500}$.

Studies on Phylloxera. (Continued.)—M. Max Cornu.—The insect attacking the leaves is the same as that attacking the roots, but it is less attracted by the former.

Reproduction of Phylloxera of the Oak.—M. Balbiani.—The reproduction of the apterous generations of phylloxera in summer is by parthenogenesis; bnt this is not the only way of reproduction of the insect.

Meteorological Observations in a Balloon.—M. Tissandier.—The ascent took place on the 4th ult. about midday, from the gas-works of La Villette. A lower current carried the aërostat in the direction E.S.E., but at a height of 700 metres there was a south-west current which carried it to the N.E. The lower had a velocity of 6 to 7 kilometres in the hour, the higher 35 kilometres. The maximum height reached was 2600 metres, where the balloon entered an extensive bank of cumulus. The polarisation of the atmosphere was here much weaker than at the surface of the ground. The hygrometric and thermometric measurements are given. The shadow of the balloon was always visible on the ground. At 1.35 p.m., and at a height of 700 metres, this shadow—projected on a meadow—appeared to be surrounded by a very bright aureole of yellow colour.

New Remarks on the Epidemic Goitre in the Barracks at St. Etienne.—M. Bergeret.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Mène, No. 41, 1873.

Vinous Syrups for the Fabrication of Low Class Wines.—These syrups are special saccharine liquids analogous to the juice of grapes, containing tannin, salts, &c., and colouring matters. It appears that they are to be mixed with the residue of the grapes after the first pressure and pressed again, so as to yield a further quantity of a liquid which may pass for wine. M. Mène thinks that by this system "dangerous and gross falsifications" may be prevented; which are a calamity to the country and to society, because they interfere with and injure not merely health, but (what M. Mène appears to think more important) "business and progress."

Destruction of the Phylloxera and other Parasites of the Vine.—Tessié du Motay waters the vine at its roots with a solution of a soluble alkaline or alkaline hyposulphite. When this solution is judged to have penetrated sufficiently, he waters anew with a solution containing a sufficient quantity of acid phosphate of lime, soda, or potash so that the excess of phosphoric acid may saturate the base of the hyposulphite, and liberate sulphur in the nascent state. In another procedure the same chemist recommends to water with an alkaline or alkaline-earthy polysulphide, and subsequently with a sufficient quantity of an alkaline bisulphite to produce the same reaction, the liberation of nascent sulphur.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 251, November, 1873.

Distribution of Potash and Soda in Plants.—M. Eug. Peligot.—This paper is taken from the *Comptes Rendus*, and has been already noticed in our columns.

Bœttger's Portable Ink.—The author saturates several sheets of paper with aniline-black, and presses them together into a compact and portable mass. For

writing it is merely necessary to tear off a piece of this paper, and steep it in a little water.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxii., No. 10, November 6, 1873.

New Fuel.—Pagliari has invented a new combustible to take the place of coal. It consists of—

Distilled petroleum	20 kilos.
Resin	30 ,,
Coal dust..	40 ,,
Charcoal dust..	30 ,,
Saw dust..	6 ,,
Sulphate of lime	10 ,,
	136

The petroleum is placed in a metal boiler heated by steam, the temperature being gradually raised to 75°. It is constantly stirred, and when the resin is dissolved the steam is shut off, and the other substances are introduced. When the whole is thoroughly incorporated it is run into moulds. Clay may be substituted for the coal. In another formula 25 parts of crude petroleum are substituted for the 20 parts of distilled petroleum. It is announced that the calorific power of this combustible is double or even triple that of coal. (We doubt whether a mixture containing nearly one-fourth its weight of resin, can ever seriously compete with coal even at present prices.)

Revue Scientifique de la France et de l'Etranger, November 1 and 8, 1873.

These numbers contain no chemical matter.

Gazzetta Chimica Italiana, Anno iii., Fascicolo ix., 1873.

Action of Cyanide of Potassium on Bichloracetic Acid.—D. Amato.—In a former notice the author speaks of a substance of a finely crystalline appearance. Its composition is—

Carbon	41·5
Hydrogen	5·7
Nitrogen	16·0
Oxygen	36·8
	100·0

and its formula $C_6H_{10}N_2O_4$. The author treats likewise on the action of cyanide of potassium upon dilute alcohol, and on a new method of preparing allophanic ether.

New Reagent for Iodates.—Egidio Pollacci.—The proposed reagent is very sensitive, and can be applied as well in cases where the iodates are unmixed as where they are associated with iodides. If phosphorus is placed in contact with an aqueous solution of iodate of potassium the iodine of such salt, however dilute may be the solution, is perfectly reduced. The same reaction occurs with other iodates. The first action is a partial reduction of the iodate, with formation of phosphoric acid and iodide of potassium. Subsequently the phosphoric acid acts upon the iodide as well as upon the iodate, forming phosphate of potash, and iodic and hydriodic acids. Lastly, these two acids being incompatible form water and iodine.

Bulletin de la Societe Chimique de Paris, tome xx., Nos. 6 and 7, October 5, 1873.

Reciprocal Action of Oxalic Acid and of the Polyatomic Alcohols; Application to the Manufacture of Formic Acid.—M. Lorin.—The author has previously pointed out the principal phenomena resulting from the reciprocal action of oxalic acid and glycerin. He finds that the same acid gives identical results with ordinary glycol, octylic glycol, erythrite, mannite, dulcite, and quercite. From the first addition of an equivalent of common oxalic acid, the formic acid is almost entirely fixed upon the equivalent of polyatomic alcohol. The physical properties of the alcohol exert an influence upon the stability of the oxalic acid. Water has also an influence contributing to the regular etherification of the oxalic acid and to the constancy of the limit. For the preparation of formic acid, 1·120 kilos. of pure glycerin and 3 kilos. of powdered oxalic acid were placed in a roomy retort. The reaction was kept up by making successive additions of the acid, morning and night, in such quantities that the original level of the mixture was kept up. The retort was cooled a little before each addition. 65·25 kilos. of oxalic acid yielded 42·14 kilos. of formic acid at 54·6 per cent = 23·004 kilos. of pure acid.

Hydrochlorate of Tereben, and on the Isomerism of the Compounds of the Formula $C_{10}H_{16}HCl$.—M. J. Ribau.—The hydrochlorate of tereben consists of—

Carbon	69·58
Hydrogen	9·85
Chlorine..	20·57
	100·00

It fuses at 125°, and is rapidly decomposed in contact with water.

Solubility of Sulphate of Lead in Acetates.—H. C. Debbits.—The author finds that sulphate of lead is soluble in the acetates of soda, lime, manganese, zinc, nickel, and copper. The acetates of mercury and silver have no such solvent action. The acetate of baryta, at common temperatures, partially converts the sulphate of lead into acetate of lead and sulphate of baryta; the inverse reaction does not take place.

Certain New Sulpho-Salts.—R. Schneider.—The author has examined the sulpho-palladiate of potash and sulpho-palladiate of silver; tetra-platinous sulpho-stannate and tetra-platinous sulpho-platinate.

Artificial Production of Crystalline Fluor-Spar and Sulphate of Baryta.—Th. Scheerer and E. Drechsel.—Fluor-spar has been obtained in octohedral crystals by fusing the amorphous fluoride in the chlorides of calcium, potassium, or sodium, and cooling slowly. The authors have also obtained the fluoride of barium in crystals on evaporating its solution in dilute nitric acid.

Sulphate of Ethylen Diamin.—M. von Lang.—This compound, belonging to the tetragonal system, exhibits the phenomena of circular polarisation. Its crystals have the forms p, a_1, $b_{\frac{1}{2}}$, &c. The ratio of the axes = 0·6692 : 1. These crystals, without exhibiting hemihedrism, polarise some to the left and others to the right. The solutions appear inactive. It is isomorphous with the sulphate of platino-diammonium, $SO_4(PtN_4H_{12})$, the crystals of which have been recently determined by Topsoe. Ratio of the axes = 0·6899 : 1. These crystals do not display circular polarisation.

Action of Sulphydrate of Potassium on the Aromatic Nitriles.—A. Weddige.—The author has caused this body in alcoholic solution to act upon pure cyanide of benzyl. The result was α-toluic amide, $C_6H_5,CH_2,CONH_2$.

Preparation of the Bromides of Quinine, Morphia, and Strychnia.—G. Macdonald.—The author prepares these bromides by exactly decomposing the sulphates by the bromide of barium, and evaporating the filtered liquid. The hydrobromate of quinine forms silky crystals, apparently anhydrous and soluble in 4 parts of cold water.

Reactions of Apomorphia.—MM. Quehl and Kœhler.—Apomorphia gives with sulphocyanide of potassium a white curdy precipitate, soluble in heat. With the yellow ferrocyanide, the solution becomes reddish and opalescent, and deposits fine flocks, which separate more quickly if heated, agglutinate, and turn green. The red (ferri-) cyanide gives a curdy precipitate, which turns violet on heating. Tannin gives a greenish yellow precipitate, which

does not dissolve on heating. With chloride of gold, there is formed a bulky purple precipitate. With picric acid, there appears, even in very dilute solutions, a lemon-yellow precipitate soluble on heating. Sulphate of copper gives a bluish turbidity, which turns green on heating. Iodide of potassium gives a blood-red precipitate, which disappears on heating. Stannous chloride produces a white precipitate, soluble on heating.

Researches on Curarin.—A. Fluckiger.—With oxidising agents in presence of sulphuric acid, curarin gives the same violet colouration as strychnia, but the purity of the shade is injured by a brown accompanying body. If a saturated solution of bichromate is added to extract of curare, preferably prepared with dilute glycerin, uncrystallisable chromate of curarin is precipitated, whilst that of strychnin crystallises readily. Chromate of curarin dissolves in sulphuric acid with an intense, but transient, blue, while the chromate of strychnia becomes violet.

New Researches on the Coagulation of Fibrin.—A. Schmidt.—To precipitate completely the fibrino-plastic matter from serum, four drops of acetic acid should be added to 10 c.c. of ox-blood diluted with 15 volumes of water, and free from globules. All substances which decompose oxygenated water seem by their mere contact to promote the coagulation of fibrin.

Quick Bleaching.—The goods are plunged in a bath containing 2·5 to 3·3 kilos. of chloride of lime per hectolitre of water. After six to twelve hours, it is washed, and boiled two to four hours in a bath of carbonate of soda, containing 650 grms. of soda per hectolitre. If the fibre is very hard it is plunged, before boiling in the soda bath, into an acid bath containing 3 kilos. of sulphuric acid per 100 litres, and allowed to drain before boiling. It is then washed, and put in a bath, hot or cold, of 2·5 to 3·3 kilos. of chloride of lime, and 700 grms. of soda per hectolitre, and washed after four to six hours.

Use of Bisulphide of Carbon in Cleansing Wool.—M. Jean.—The sulphide of carbon does not injure wool in the cold, and removes the grease readily. Its removal by means of a current of cold air is tedious, and involves considerable waste. If steam or hot air be employed, the wool loses its softness and elasticity, and takes a permanent yellow tone; benzol is therefore far preferable.

Reimann's Färber Zeitung, No. 39, 1873.

This number contains a receipt for a safflower-rose on glazed calico. The dressing consists of 50 lbs. of wheat-starch, 20 lbs. of wheat-flour, 4 lbs. of white wax, and 6 lbs. of cocoa-nut oil, a little sulphuric acid being added to the water in which the starch is mixed.

There are also receipts for a light and a deep prussian blue on glazed calico; for a green (extracts of indigo and of quercitron) on jaconnets; a peach-wood crimson on glazed calico and jaconnet; a brown on calico with Bismarck brown and magenta; a grey drab on wool; and a scarlet on woollen cloth and flannel; also, a blue (soluble aniline blue) and a coffee-brown on plush; a violet on woollen yarn. The mordant in this case consists of 1½ ozs. of tannic acid dissolved in hot water in which ¼ oz. of Marseilles soap is next dissolved; ¼ oz. of rape oil is next added, and stirred up till it forms an emulsion. The liquid is used at 60° R. The bleached yarn is worked in this mordant for fifteen minutes, and then withdrawn. The colour-bath, at the same temperature, is prepared with 5 ozs. of alum and the clear solution of 1 oz. of methyl violet.

There is also a prescription for a light green on cotton yarn, the colour being methyl green fixed with tannic acid.

The editor gives a receipt for a brown on shoddy, containing a mixture of cotton, called on the Continent "velour." To 100 lbs. of this material, make up a bath of 30 lbs. of fustic, 3 lbs. of alum, 2 lbs. of prepared tartar, and 1 lb. of blue vitriol, in which the shoddy is boiled for half an hour. To the same flot are then added 1 lb. of chromate of potash and ¾ lb. of "aniline red," "ruby," or "aniline crimson," known on the Continent as "rosain." The dyeing is carried on at a gentle boil, and turmeric added to modify the shade. Logwood may be used, if needful, to darken. Aniline red is a refuse magenta; it is dissolved in hydrochloric acid, and boiled in water previous to use.

Test for Chrome Yellow and Orange.—M. Duvillier.—The author proposes to test these colours for sulphate of lead by heating 1 part of the colour with 3 parts of nitric acid at 1·420, 2 parts of distilled water, and ¼ part of alcohol. The chromic acid set at liberty oxidises the alcohol. The mixture is heated till nitrous fumes are no longer given off. The remaining liquid contains nitrate of lead and chromic oxide, and a white precipitate of nitrate of lead, mixed with sulphate if any be present. The whole is mixed with water, and boiled, when sulphate of lead alone remains. A much simpler process is to treat the sample with potash lye, when the colour dissolves and sulphates of lead remains. The possible presence of the sulphates of strontia and baryta has been overlooked by the author, upon whom Dr. Reimann passes some very severe strictures.

Protartar for Woollen Dyeing.—10 kilos. of alum, dissolved in 40 litres of hot water; 3·5 kilos. of oxalic acid, dissolved in 20 litres of hot water, and 2 kilos. of acetic acid. As compared with tartar, this mixture is said to effect a saving of 50 per cent.

No. 40, 1873.

This number contains receipts for a catechu brown on glazed calico; an iron buff on stout cotton goods; for a deep olive-green and a drap on wool; a coal-black, a blue-black, and a deep corinth on plush; also, a black on cotton yarn, capable of bearing milling; and a blue on shoddy, the cotton in which has been first destroyed by the vapour of hydrochloric acid, and the residue neutralised with chalk. In dyeing, a preparation is used, known as "shoddy-carmide." It is made by dissolving in two pails of hot water—12 lbs. of alum, 9 lbs. of indigo-carmine, and 3 lbs. of soluble aniline blue.

Preparation of the Hair of Rabbits for the Manufacture of Felt Hats.—These hairs were formerly treated with a solution of mercury in nitric acid, for the purpose of enhancing their felting properties. A mixture of nitric acid and treacle is proposed as a substitute.

No. 41, 1873.

This number contains receipts for an iron-grey on silk; a "naturel" on stout cottons and on gauze; for greys on a variety of materials; for a black on half-worn clothes; for a medium brown, a yellow-brown, and a dark and light brown on plush; a white on wool, blued slightly with alkali-blue R, or methyl-violet BBBBB; a violet-brown colour for printing on cotton yarns (warp printing); and a flavin-yellow on calico.

Archiv der Pharmacie, July, 1873.

Sugar Found in Grass Roots; and on Triticin, a New Carbohydrate from the Roots of Triticum repens. (Conclusion).—H. Müller.

Oleate of Mercury with Oleate of Morphia.—Ch. Rice.

Cheap Disinfectant.—E. C. C. Stanford.

Action of Dilute Saline Solutions on Lead.—M. P. Muir.

Colouration of Chloral Hydrate with Oil of Peppermint.—C. Jehn.

Tests for Creosote and Phenol.—J. A. Flückiger.

Detection of Alum in Bread.—J. Horsley.

Distribution of Nitrogen in Certain Kinds of Straw.—C. Schneider.

MISCELLANEOUS.

University of London.—The following is a list of the candidates who have passed the recent Second B.Sc. examination:—First Division—J. A. Hullard, First M.B., University College; L. Lyell, private study; A. M. Marshall, B.A., St. John's College, Cambridge; H. S. Roberton, B.A., Old Trafford School and Owens; C. A. Weber, B.A., University College; J. C. Witton, private study. Second Division—J. Barnes, Owens College and private study; C. Bulbeck, private study; F. Chapple, B.A., Wesleyan College, Westminster; A. W. Fuller, Owens, and Emmanuel, Cambridge; C. W. Huson, Queen's College, Liverpool; A. S. Napier, Owens College; A. Speers, private study; J. H. Taylor, M.A. Oxon and Camb., private study; S. H. Vines, First M.B., Christ's, Cambridge, and Guy's Hospital; W. B. Worthington, Owens College.

Dr. Emerson Reynolds.—On the 24th ult., Dr. Emerson Reynolds, Professor of Analytical Chemistry to the Royal Dublin Society, and Keeper of the Mineral Department, was appointed Professor of Chemistry to the Royal College of Surgeons in Ireland. On the 14th inst., Dr. Reynolds was appointed Examiner in Medical Jurisprudence and Toxicology in the Queen's University in Ireland.

The Late Dr. Crace-Calvert.—We are informed that Mr. William Thomson will, in conjunction with Mrs. Crace-Calvert, continue to carry on the business of Analytical Chemist, formerly conducted by Dr. Crace-Calvert, at the Royal Institution, Manchester, under the firm of Crace-Calvert and Thomson. Mr. Thomson has had more or less the management of the business for the last five years.

NOTES AND QUERIES.

Tartaric Acid.—Would you kindly oblige me by informing me through your valuable paper how the tartaric acid might be recovered from a solution of tartrate of soda?—C. Smith.

Indigo.—Will some one of your readers inform me where I can find an account of the most recent and fullest researches upon indigo. Also the best description of apparatus and processes used in the manufacture of what is known commercially as extract of indigo.—Colour.

The Estimation of Sulphur in Pig-Irons.—The "simple and ready method" described in p. 248 Chemical News, by Mr. Piesse, is a very old one in common use in metallurgical laboratories, and described in rudimentary metallurgical treatises. The result obained is somewhat below the truth, as some of the sulphur may escape oxidation, and pass off in combustion with the hydrogen evolved. I have found that nitric acid, sp. gr. 1·2, is more convenient as a solvent than aqua regia; though liable to the same objection the loss of sulphur is less variable than when aqua regia is used.—W. Mattieu Williams.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the purification of water and apparatus connected therewith, together with the mode of cleansing the same. Arthur Charles Henderson, of the firm of Henderson and Co., British and Foreign patent agents, 31, Charing Cross, Middlesex. (A communication from Gustave Demailly, civil engineer, Brussels.) February 18, 1873.—No. 591. This invention consists in purifying water before use, either in domestic or industrial purposes, by a combined chemical and mechanical process, freeing it from calcareous and other matters held in solution, by adding thereto a small proportionate quantity of solution of caustic lime, which, troubling the water, presents a precipitate formed by the action of the carbonic acid by immediately depositing carbonate of lime, so that, instead of having to treat matters in solution, it merely remains to operate on matters in suspension. The apparatus for effecting this consists of a filter formed of a cylindrical vertical case of sheet- or cast-iron furnished with a lid; in this another cylinder is contained, which is the filter proper, also formed of sheets of cast- or sheet-iron, one at the top and the other at the bottom, and united by three concentric cylinders of perforated sheet-iron. These cylinders form two annular capacities supplied with filtering matter composed of felt or wool rendered imputrescible. The water arrives in the filter by a tap, spreads itself between the envelope and the filtering cylinder, then by pressure it traverses the latter, and makes its exit by a discharge-tap perfectly clear and freed from all matters in suspension. The cleansing of the filter is effected, without the necessity of taking the apparatus to pieces, in the following manner:—When the steam-engine is stopped, the tap admitting water into the filter is closed, as well as the exit-pipe communicating with the feed-pump, which allows of free communication with the central pipe of the filter and water-draught of the generator. On opening the discharge-tap, it will at once be seen what has taken place. The pressure of the generator sends the water already purified into the central pipe of the filter; this water traverses inversely the beds or layers of filtering matter, and draws along with it the foreign organic matter arrested during filtration, and flows out by the discharge-tap. The whole cylindrical body is also movable on a pivot, and is made to revolve so that it comes under the influence of a brush fixed vertically at the inner side of the case, which suffices to dislodge any residue.

Improved combinations of ingredients for removing acidity from ales, beers, porters, wines, &c., and also to preserve them from acidity. Charles William Sutton, of the firm of Sutton & Company, of Stowmarket, Suffolk. February 18, 1873.—No. 599. This consists in the employment of hydrate of lime and chloride of sodium in combination, or hydrate of lime and chloride of ammonium, in suitable quantities with distilled water for depriving ales, beers, wines, &c., of excess of acid, and also for preserving them from acidity.

Improvements in photo-mechanical printing, and in apparatus to be used in such printing. William de Wiveleslie Abney, St. Margaret's Street, Rochester, Kent. February 19, 1873.—No. 615. This invention consists in coating a flexible sheet of paper or linen with a solution of gelatine made sensitive to light with bichromate of potash, with or without the addition of chrome alum or other analogous substance. The sheet so coated is dried and exposed to light under a photographic negative, and after having been washed is placed upon a flat support, upon which it is pressed, and the picture upon its surface is inked with greasy ink by means of soft rollers, and is then transferred to the surface of stone or zinc in the usual way, and pictures are obtained from it in a lithographic printing press. By this method the film is inked whilst still wet, and the photographic negative need not be reversed, nor is it necessary that it should be of great density in its opaque parts.

Improvements in the manufacture of mortar, beton, and concrete. Humphrey Chamberlain, engineer, Round Green, Barnsley, York. February 19, 1873.—No. 623. This invention consists essentially in the application and use to, and in the manufacture of, mortar, beton, and concrete of the waste lime from gas purifiers, which has hitherto been treated as a comparatively useless refuse. I have found by experiment that "gas lime," by which name such before-mentioned waste lime is known, produces an equally good or superior mortar to fresh lime. It is simply requisite to grind it up in the usual mortar-mill, or to mix it as ordinary lime with sand, ashes, and such like materials. The said refuse lime is also suitable as a substitute for fresh lime in making concrete or "beton," which may or may not, as required, be moulded into bricks or blocks in any well-known manner, and in the event of a very hard substance being required, a portion of Portland cement may be used in combination with the said refuse lime.

Improvements in purifying fusty and otherwise impure casks, and in seasoning new casks and timber to be made into casks. R. J. Tremlin, brewer, Maidstone, Kent. February 20, 1873.—No. 640. This Provisional Specification describes employing bisulphite of lime mixed with water, heated by steam, or it might be hot air being blown into or through it, or being otherwise heated.

Improvements in the mode of and apparatus for treating marine plants called sea-weed, sea wrack, and algæ, in order to obtain useful products therefrom for industrial and other purposes. Michael Henry, patent agent, Fleet Chambers, 68, Fleet Street, London. (A communication from the Société Collet et de Lavillasse, Landernau, and 17, Boulevart St. Martin, Paris.) February 20, 1873.—No. 650. Sea-weed, wrack, algæ, or marine plants are treated preferably when fresh from the water, before drying. They are incinerated in a close furnace into which air is blown or forced. The gases or vapours, with the matters held in suspension, are condensed in damp condition. The utilisable products that escape from the main combustion may be brought back to the furnace. A furnace is described in which hollow fire-bars (wherein air or water circulates) are used, and the materials fall on to a plate, under which there may be a second grate, and thence they are raked into moulds. The gases and vapours, with the matters which they hold in suspension, pass into a chamber in which there is an air or water circulation. Cold water may be showered in. The products are collected in channels leading to a receiver. A fan or blower extracts the air from the chamber and passes it into the furnace.

Improvements in arrangements and apparatus for preparing peat, small coals, coal-tar, petroleum, or other similar substances, for fuel. Murdoch Campbell, Clonreher Castle, Maryborough, Queen's County, Ireland. February 21, 1873.—No. 656. Improvements consist in macerating the peat into pulp, by means of suitable mills, without water, or with water, petroleum, or coal-tar added thereto; afterwards it is moulded into solid, hollow, or perforated blocks or bricks, by passing it through the dies of brick-making machinery. Small coals and coal-tar are also mixed together and moulded into blocks or bricks in like manner. The drying shed is heated artificially and ventilated by a self-acting screw cowl fitted on top of shed.

THE CHEMICAL NEWS.

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ALUM IN BREAD.

IT is unfortunate that proceedings under the Adulteration Act should have been taken in the matter of the so-called adulteration of flour and bread with alum. In the first place, it is highly probable that this so-called Adulteration is a meritorious Act, and that the inventor of it deserves a civic crown, as would be due to him who should increase the harvest every year. Alum is added to flour and bread in order that flour, which otherwise would not make good bread, may be enabled to do so. By treatment with a trace of alum, flour of doubtful soundness is endowed with soundness. For this purpose a proportion of alum is required which does not exceed 20 grains to a 4-lb. loaf.

One of the most important functions of the public analyst is to withstand popular clamour and to oppose professional prejudice—prejudice which owes its origin to imperfect acquaintance with the matter in hand. And this case is an illustration in point. The 20 grains of alum have been sensationally dealt with; and the people, and professional persons who ought to know better, have attributed tanning of the stomach and ruin of the digestion to these 20 grains of alum in the 4 lb. loaf.

Nothing is easier than to show the unreasonableness of such notions; and perhaps some of those persons who are suffering from them will be surprised to be told that the phosphate of potash in a 4-lb. loaf (and which existed in the flour of which the 4-lb. loaf is made) is far more than enough to transform the alumina contained in the 20 grains of alum into phosphate of alumina.

It is useful to call to mind that of the 20 grains of alum about half is water, and that there are only about 2·2 grains of real alumina (Al_2O_3) in 20 grains of alum.

Under these circumstances, we are almost tempted to rejoice in the difficulties which beset the public analyst in his attempts to detect traces of alum in bread. We are not surprised that the public analyst returns bread which has been purposely alumed as being devoid of alum, inasmuch as the detection of traces of alum in presence of the constituents of the ash of bread is one of the most difficult problems of chemical analysis.

In connection with this subject the following remarks on the detection of alum in bread, published by the Editor of this journal some years ago, may not be inappropriate at the present time:—

"This problem is one of far more difficulty than is generally imagined, and it is doubtless to this fact that the discordant results obtained by different analysts are to be attributed: one stating that out of sixty-four samples of bread purchased at various shops in poor neighbourhoods at the East of London, where, if anywhere, adulteration would be practised in the most barefaced manner, not a single one was found to contain alum; whilst another analyst, with equal positiveness, mentions the name of a baker who is, in his opinion, almost the only person in a large district at the West End of London who sells unadulterated bread, and proceeds to state that more than 87 per cent of the bread in London is adulterated. Very few of those who have published anything on this subject give details respecting the process they adopt, but in most instances it seems to be somewhat to the following effect:—The bread is first charred and burnt nearly to an ash; the latter is then boiled in diluted hydrochloric acid, with which a little nitric acid has been mixed; ammonia is then added, and the precipitate which it produces is boiled in potassa. After filtration, hydrochloric acid is to be added in excess, and then ammonia, when it is supposed that the precipitate will consist of alumina. With a pure solution of alumina to start with, doubtless this process would give accurate results; but it must be remembered that in bread the alumina would be accompanied by phosphoric acid, as well as phosphate of lime and phosphate of magnesia, each of which would make its appearance in the last precipitate with ammonia, and would consequently pass for alumina. But, granting that this tendency of the phosphates of lime and magnesia to simulate the reactions of alumina had been provided against, it seems to have been almost entirely overlooked by popular writers on this subject that whenever alumina and phosphoric acid meet together in solution, they adhere with the greatest pertinacity, and will infallibly appear together in the last precipitation. I should not have deemed these points worthy of mention did I not know that many analysts are habitually employing similar processes to the above, and are even estimating quantitatively the amount of adulteration in bread by weighing this precipitate of the mixed phosphates of lime, magnesia, and alumina, and calculating it as pure alumina.

"My attention was first drawn to this subject by the fact that a sample of bread which was known to be entirely free from adulteration had been pronounced by a somewhat experienced analyst as being largely adulterated with alum. My assistance was asked in order to disprove this injurious allegation, and, having accordingly submitted the subject to a somewhat lengthened examination, I am induced to lay the results before the readers of the CHEMICAL NEWS, in the hope that, when the attention of chemists is drawn to the subject, it may be investigated as fully as its commercial importance deserves.

"The great difficulty in my hands has been to devise a process which should not confound other things with alumina. It was easy to frame various modes of operating by which a minute trace of alumina could be detected, but I was for a long time baffled by finding that they were equally delicate in their reactions, whether alumina were present or not. In fact, I do not hesitate to say that the accurate analysis of a mixture of those phosphates which are precipitated from an acid solution by ammonia is one of the most difficult problems in inorganic chemistry that the chemist is liable to meet with in technical analysis. I do not pretend to have yet solved the difficulty, but the process which I have at last adopted has at least the merit of not showing the presence of alumina when that body is absent. It has, on the other hand, the inconvenience of being rather tedious in its manipulation, and to some may seem to be needlessly complicated. No one can be sensible of this fact more than myself; but of the numerous methods which I have tried, both with and without separating the phosphoric acid, this was the only one which invariably gave me trustworthy results.

"The bread, of which at least 500 grains should be taken, is first to be incinerated in a platinum or porcelain dish, until all volatile organic matter has been expelled and a black carbonaceous ash remains. The temperature must not be raised much beyond the point necessary to effect this. Powder the coal thus obtained and add about thirty drops of oil of vitriol, and heat until vapours begin to rise; when sufficiently cool, add water and boil for ten minutes. Filter and evaporate the filtrate until the fumes of sulphuric acid begin to be evolved, when ten grains of metallic tin and an excess of nitric acid must be added, together with water, drop by drop, until action between the acid and metal commences. When all the tin i

oxidised, add water and filter. Evaporate the filtrate until fumes of sulphuric acid are again visible, when more water must be added, and the liquid again filtered if necessary. To the clear solution now add tartaric acid, then ammonia in excess and sulphide of ammonium. Evaporate the liquid, containing the precipitate suspended in it, in a dish, until all the smell of sulphide of ammonium has disappeared. Filter, evaporate to dryness, and ignite to get rid of the organic matter. Powder the black ash, boil it in moderately strong hydrochloric acid, filter, add a crystal of chlorate of potash, and boil for a minute. Now add chloride of ammonium and ammonia, and boil for five minutes. If, at the end of that time, any precipitate is observed it will be alumina. From the filtered solution, if oxalate of ammonia be added, the lime will be precipitated; and if to the filtrate from this, ammonia and phosphate of soda be added, the magnesia will come down."

PRELIMINARY INVESTIGATION OF THE FLUORESCENT AND ABSORPTIVE SPECTRA OF THE URANIUM SALTS.*

By HENRY MORTON, Ph.D.,
and H. CARRINGTON BOLTON Ph.D,

(Continued from p. 259).

Double Sulphates.

Uranic sulphate has heretofore been known to form the following double salts:—

$U_2O_3SO_3 + NH_4OSO_3 + 2HO.$
$U_2O_3SO_3 + NaO\ SO_3 + 5HO.$
$U_2O_3SO_3 + KO\ SO_3 + 2HO.$
$3(U_2O_3SO_3) + 2KO\ SO_3 + xHO.$ (?)

The last-named was obtained by Berzelius, but Ebelmen and Péligot could not reproduce it. To this list we have added the following new compounds:—

$2(U_2O_3SO_3) + NH_4O\ SO_3.$
$U_2O_3SO_3 + MgO\ SO_3 + 7HO.$ (?)
$U_2O_3SO_3 + MgO\ SO_3 + 4HO.$
$U_2O_3SO_3 + RbO\ SO_3 + 2HO.$
$U_2O_3SO_3 + HO\ SO_3 + 3HO.$

The history of the ammonio-diuranic sulphate has been already given in a previous part of this paper, and we need only add here that we have as yet been unable to prepare it otherwise than by the decomposition of the ammonio-sulphate as there described. Both the magnesium salts were formed under conditions seemingly identical, when a cold solution of the mixed sulphates was allowed to concentrate over sulphuric acid.

When solutions of equivalent weights of uranic sulphate and rubidium sulphate are brought together, and the proper degree of concentration has been reached, warty concretions of minute crystals form, possessing a hue of remarkable beauty and a brilliant fluorescence. So strong is this that the white porcelain dish in which the crystals form appears pink by contrast.

Thallio-uranic sulphate forms in a precisely similar manner, but is of a golden yellow colour with a fine lustre, but very slight fluorescence. It is not readily soluble in water, but is very stable, being easily re-crystallised from hot solution. Analysis of these salts has not been completed in time for insertion in this preliminary notice.

We will now pass to the optical study of these salts in their alphabetical order.

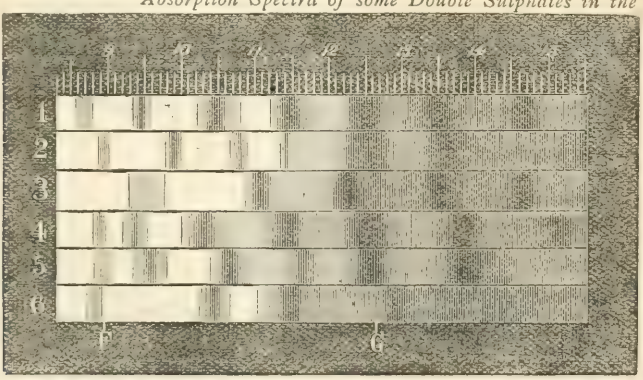
Ammonio-Uranic Sulphate, $U_2O_3SO_3 + NH_4OSO_3 + 2HO$. —The spectrum of this salt has been already described, but for completeness we will here reproduce it with some additional data. The bands of this substance are distinguished by great abruptness on their more refrangible side, rising as it were suddenly to a narrow brilliant line, and then fading off gradually on the lower side in a manner suggesting a rounded convex surface. Their positions are shown in 1 of Fig. 20.

In the first experiments made with this salt it was heated to about 200° C. to drive off its water, but subsequent experience showed that the same result might be reached by a continued application of a temperature of 100° C. Two atoms of water in this salt would amount to 6·71 per cent; and it was found that a specimen bottle placed in a hot-water oven continued to lose weight for about twelve hours. At the end of this time its total loss was 7 per cent, and its weight then remained constant, even when it was heated to about 250° C. Its fluorescent spectrum was then that shown at 3 of Fig. 20. Its characteristic was a new position of the bands, and a much more rounded and less brilliant appearance. This salt does not appear to form any mono-hydrate, and in fact presents a great contrast to the uranic sulphate and sodio-uranic sulphate as regards the fixity of its two forms, the normal or bihydrate and anhydrous state. The position of its absorption-bands has been already shown at 10 of Fig. 1, and will also be seen at 1 of Fig. 19.

Ammonio-Diuranic Sulphate, $2(U_2O_3SO_3) + NH_4OSO_3$. —This salt, which, as we have before stated, is obtained by heating the dried ammonio-uranic sulphate in an open vessel to a temperature of about 325° C., or, in other words, a heat competent to fuse lead in the same vessel, and which will then bear a temperature little short of redness without further decomposition, yields a spectrum such as is represented in 5 of Fig. 20, and whose bands are as bright and sharply defined on the upper edge as those of the hydrated ammonio-sulphate; from which they are to be distinguished only by their position, and perhaps by their greater breadth descending more gradually into the

Fig. 19.

Absorption Spectra of some Double Sulphates in the Solid Form.



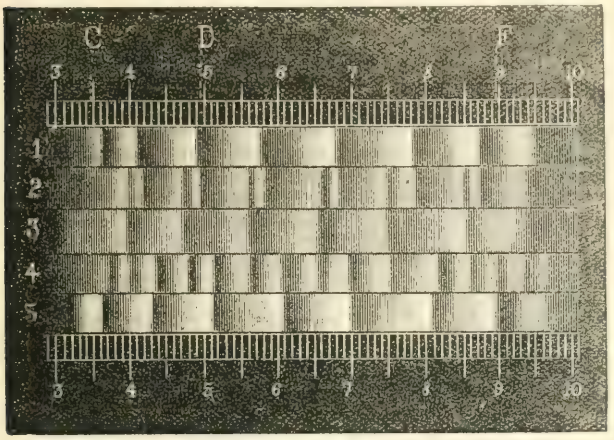
Ammonio-uranic sulphate.
Ammonio-diuranic sulphate.
Magnesio-uranic sulphate.
Rubidio-uranic sulphate.
Sodio-uranic sulphate.
Thallio-uranic sulphate.

* Communicated by President Morton.

dark spaces ... the lower side. The ... of the cut are not correctly ... and the second too high. They should show an even spacing, one having its upper edge at 70·5 and the other at 80. The absorption spectrum of this salt is shown at 2 of Fig. 19.

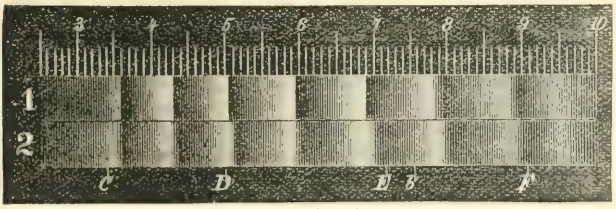
Magnesio-Uranic Sulphate.—As we have already noticed, a mixture of uranic and magnetic sulphates will form two compounds, one of these, which seems easy to reproduce, having the formula $U_2O_3SO_3+MgOSO_3+4HO$. The other

FIG. 20.



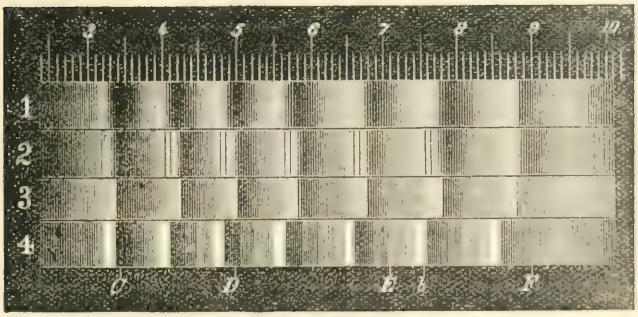
Ammonio-Uranic Sulphates.

FIG. 21.



Potassio-Uranic Sulphate.

FIG. 22.



Sodio-Uranic Sulphates.

we have only succeeded in obtaining once in small quantity. This and the fact that it was then mixed with magnesium sulphate, render an accurate analysis impossible, but a determination of the water and sulphuric acid seems to indicate that the body has the formula $U_2O_3SO_3+MgOSO_3+7HO$. We would, however, only present this as a suggestion. The two salts yield fluorescent spectra, which are entirely distinct in the positions of their bands, although both are alike, and of what we have called the normal form in their general character. The following table will show this

Fluorescent Spectra of Magnesio-Uranic Sulphates.

Bands.	1.	2.	3.	4.	5.	6.	7.	8.
A ..	—	40·4	48·0	55·5	65·7	74·6	84·8	91·6
B ..	—	44·8	53·0	66·4	70·8	81·0	90·5	96·0

The measures here given are of the upper edges of bands' except the 8th, which is measured at its centre. The absorption spectrum of the normal salt, A, is given at 3 of Fig. 22, and is characterised by the absence of the lower bands found in other double sulphates.

Potassio-Uranic Sulphate, $U_2O_3SO_3+KO,SO_3++2HO$.—This salt readily crystallises out when a solution of the mixed sulphates in atomic proportions is allowed to evaporate in the air; it forms warty concretions of minute crystals of a yellow-green colour and very bright fluorescence. In this state it contains 2 atoms of water, and shows the spectrum represented in 1 of Fig. 24, which is of the normal character, with a sharp termination of each band on its upper edge, and the bands peculiarly broad and bright.

This salt suffers no change by heating or drying at 100° C., but if dried at 150° C. it loses all its water, and its spectrum changes to that shown at 2 of Fig. 21, in which the bands are much rounded, and displaced a little upward in the spectrum. It would thus appear that this salt can exist, and display fluorescent action as a bihydrate and anhydrate, but we have obtained no evidence of its forming a monohydrate.

The absorption spectrum of the hydrated salt will be seen at 1 of Fig. 19, being indistinguishable from that of the ammonio-salt. The spectrum of the anhydrate is more difficult to observe, but by using the substance in powder with a little oil between slips of glass we can make out bands whose centres are at 93·7, 101·0, 111·7, and 124·4 respectively, and which are therefore quite unlike those of the normal salt.

Rubidio-Uranic Sulphate, $U_2O_3SO_3+RbOSO_3++2HO$.—The preparation of this salt we have already described, and we will therefore pass at once to its fluorescent spectrum. In this the bands are much blended or rounded, and are decidedly lower than the corresponding ones of the potassium salt. Their brightest parts are located as follows:—

Fluorescent Spectra of Rubidio-Uranic Sulphate.

1.	2.	3.	4.	5.	6.	7.	8.
34·0	41·6	49·2	57·6	66·7	76·0	85·2	94·8

This substance loses 2 atoms of water if it is dried at 100° C., but its fluorescent spectrum is not changed as regards the position of its bands; the brightness of its fluorescence is, however, reduced. An exposure to a yet higher temperature (180° C.) causes a slight loss of weight (0·6 of 1 per cent), and yet further reduces its fluorescence without other effect. The absorption spectrum of the normal salt will be found at 4 of Fig. 19.

Sodio-Uranic Sulphate, $U_2O_3SO_3+NaOSO_3+5HO$.—This salt presented more difficulties at the outset than any other, and, as might be expected, has yielded some very curious results. Thus a certain specimen was observed to yield the peculiar spectrum shown at 2 of Fig. 22, while the rest of the crop of crystals in another bottle from which it had been taken showed nothing of the sort. A prolonged study of this body has evolved the following facts, and has shown that many more await further investigation:—This salt in its normal state, containing 5 atoms of combined

water yields the spectrum shown at 1 of Fig. 19, which is of the normal type. A portion of this water is, however, lost with great ease, occasioning the formation, under ordinary conditions, of mixtures of several hydrates. Some of these we have been unable to isolate and determine, but we have found that, by gradually drying at a temperature of 150° C., we obtain a monohydrate whose spectrum is that shown at 3 of Fig. 19. If the salt in a damp state is placed suddenly in the oven at 150° C., it will lose almost all its water, and give a spectrum sensibly continuous; in this condition it may be dried at 200° C. without suffering any change. When heated to 250° to 290° the salt loses all its water, and then acquires a spectrum such as is shown at 4 of Fig. 19, in which each band looks like a prismatic column. Under various conditions, which we have not yet been able to determine with certainty, intermediate amounts of water are lost, and mixtures of other hydrates are produced, in which, no doubt, salts with 2, 3, or 4 atoms of water are involved. These, once formed, will, like the corresponding hydrates of uranic sulphate, maintain themselves in the presence of desiccating treatment, which would deprive the normal salt of much more water. The absorption spectrum of the normal salt is shown at 5 of Fig. 19. It is, perhaps, unnecessary to state that the peculiar spectrum shown at 2 of Fig. 22 is believed to be produced by three or more overlapping spectra belonging to as many mingled hydrates.

Thallio-Uranic Sulphate, $U_2O_3SO_3+TlO,SO_3+3HO$.—This substance has a very faint fluorescence. Bands can be made out at 92·4 (?), 35·6, and 76·0; below the first of these three seems to be a faint continuous spectrum. This salt loses 3HO and all its fluorescence by drying at 100° C. Its absorption spectrum is shown at 6 of Fig. 19.

NOTES OF WORK BY STUDENTS OF PRACTICAL CHEMISTRY IN THE LABORATORY OF THE UNIVERSITY OF VIRGINIA.

(No. II.)

Communicated by J. W. MALLET,
Professor of General and Applied Chemistry in the University.

(1). *On the Best Mode of Converting Calcium Oxalate into Carbonate in the course of Analytical Work.* By Mr. J. R. McD. IRBY, of New Orleans, Louisiana.

CALCIUM precipitated as oxalate is sometimes weighed as such after drying at 100° C., is sometimes converted into carbonate by heating to a carefully regulated temperature just short of redness, sometimes converted into lime by heating to bright redness or beyond, and sometimes given the form of sulphate by treatment with sulphuric acid or ammonium sulphate.

Of these four modes of procedure, although accurate results can be obtained by any one of them,* the second is, on several grounds, to be preferred for general use.

If the oxalate itself be weighed, an unburnt filter, previously tared when dried at 100° C., has to be weighed with it, and the errors which may be allowed to arise from hygroscopic moisture affecting this filter at either of its weighings, and the tube or watch-glasses used to contain it are more likely to influence the result to a serious extent than those from similar causes when but the ash of a filter and a small crucible are concerned.

The conversion into caustic lime requires a very strong heat, generally obtained by means of a blast lamp, the blowing being kept up for some time. The last traces of carbon dioxide are driven off with difficulty, and the platinum crucible is liable to alter slightly in weight, while the risk of mechanical loss from the blast, and the great readiness with which moisture is taken up from the atmosphere by the lime during cooling and weighing, are not to be altogether overlooked.

The acid fumes given off during the conversion into sulphate and final evaporation are annoying, and the heating is tedious and requires very careful watching to prevent loss.

Pure calcium carbonate is undoubtedly the most stable and desirable form in which to obtain the final product for weighing, and if at once obtained by carefully managed heating of the oxalate, as may be accomplished in well-trained hands,* leaves nothing to be desired; but if the temperature be allowed to rise a little too high, and a little caustic lime be formed, the necessary evaporation with solution of ammonium carbonate is tedious and troublesome, and cannot be hastened without almost certain loss from spirting. Moreover, while a very small quantity of lime can thus easily be restored to the condition of carbonate, if any considerable amount of material have to be dealt with the moistening and evaporation will often need to be repeated more than once before the weight becomes constant. The object in heating is, therefore, to so regulate the temperature as to ensure the complete destruction of all oxalate, and to avoid altogether the decomposition of the carbonate. The statement of the writers on analytical chemistry, that the proper temperature is represented by very low redness, or should be just short of redness, is wanting in precision. Working at night or in the daytime, by bright sunlight or on a dark, cloudy afternoon, one's estimates of barely visible redness will represent by no means a small range of temperature, and it needs a good deal of personal supervision to teach a new laboratory student exactly how to proceed, so as to obtain at once, without the delays above referred to, a result so often called for as an accurate determination of calcium.

In order to simplify and give greater precision to the details of the process, it was suggested to Mr. Irby to get some better measure of the temperature really required, and to find, if possible, some empirical rule for its ready production and regulation.

Not having at command one of Siemens's electric resistance pyrometers, it was attempted to estimate the temperature needed for the decomposition of the oxalate by comparison with the melting-points of some of the metals.

Calcium oxalate (specially prepared and found to be quite pure, and fully dried at 100° C.) heated to the melting-point of lead for a short time, was found, on cooling, to have begun to decompose, but the extent of the change was quite small. At just the melting-point of zinc the weight could easily be reduced to within one or two per cent of the theoretical amount, but several hours' exposure to this temperature scarcely produced complete reduction to carbonate. Several metallic alloys were tried, in order to get from some one of them a barely-fused bath of the proper temperature, but they all gave too much trouble from surface oxidation and the tendency to separate into a more and a less fusible portion. Finally, it being ascertained that a heat but very little beyond the melting-point of pure zinc was required, the following arrangement was found practically successful.

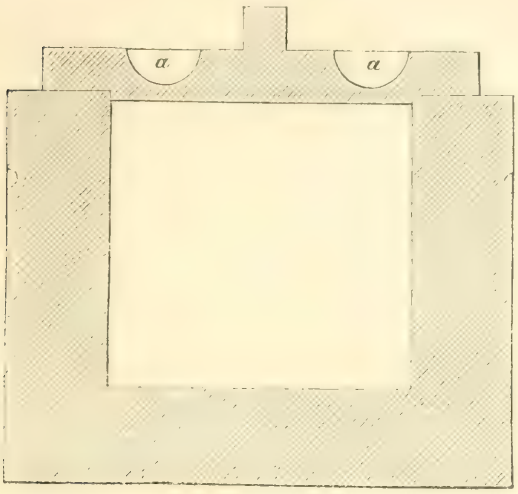
A solid cylinder of cast-iron, smoothly turned, 53 m.m. high and 66 m.m. in diameter, had a cylindrical hole of 40 m.m. deep and 40 m.m. diam., drilled into the upper end, thus producing a sort of crucible with walls and bottom 13 m.m. thick. A turned disc of cast-iron, 58 m.m. in diameter and 6·5 m.m. thick, with a little knob in the middle of the upper surface to serve as a handle, formed a cover; and in the upper surface of this cover, two hemispherical cavities, each 10 m.m. in diameter, were drilled at opposite sides, the centre of each 15 m.m. distant from the edge. Round the outside of the cylinder a little groove was turned, which enabled the whole to be supported over a lamp by a stout iron wire triangle.

* See paper by Aug. Souchay in Fresenius's *Zeitschr. f. Anal. Chem.*' 10 jahrg., 3 heft, s. 323, and remarks upon same by Fresenius in same periodical, s. 326.

* Fresenius, in his excellent "Anleitung zur Quant. Chem. Anal.,' 5 aufl., s. 201, has given minute directions as to the details.

The figure shows this thick walled crucible and cover in vertical section. The total weight was about 1050 grms.

In the little cavities (*a a*) bits of metallic zinc of about a gramme each were placed, a piece of porcelain, such as a small crucible cover, was placed in the bottom of the cast-iron vessel, and upon this a platinum or porcelain crucible (the latter being found to answer best, on account of its inferior conducting power) containing the calcium oxalate to be heated. Gas from a Bunsen burner with tube of 9 m.m. diameter was used as the source of heat, and the position of the burner was so regulated that, when the stopcock was fully opened, the flame played



over the bottom of the cast-iron block and about one-fourth up the outside all round. With quantities of 1 to 1·5 grm. of oxalate, the full flame of the lamp was turned on at once, the mass of iron in the block ensuring sufficiently gradual heating, and it was then only necessary to notice *when the bits of zinc in the cavities of the iron cover had fully melted*; the decomposition was then complete. This took about thirty minutes, but during that time no attention on the part of the operator was needed. The calcium carbonate left in the crucible was quite free from caustic lime. The following are two examples of the results :—

Calcium oxalate taken.	Calcium carbonate obtained.	Calcium carbonate calculated.	Lime (derived from oxalate) as calculated from carbonate.	Lime calculated directly from oxalate.
Grm.	Grm.	Grm.	Per cent.	
1·0388	0·7109	0·7115	38·32	38·36
1·5765	1·0792	1·0798	38·33	,,

It proved to be important that the decomposition of the greater portion of the oxalate should take place without the carbon monoxide gas given off taking fire, since the additional heat produced by its combustion through and on the mass sufficed to burn a little of the carbonate into lime, and the tendency to separation of carbon (rendering the mass dark in colour) was much greater when the gas took fire, while carbon once separated could not be well burnt off again without increasing the heat too much. The effect of too rapid heating, attended with the *burning* off of carbon monoxide, is shown by the following results, obtained in experiments in which the maximum temperature derived from the lamp was no higher than in others of entirely satisfactory character :—

Percentage of Lime obtained from Oxalate.	
Found.	Calculated.
38·18 }	38·36
38·19 }	

Hence, when the oxalate amounted to about 2 grms., it was found better to turn on the gas to the lamp somewhat gradually and to keep up the heat longer, about three quarters of an hour being required, while, for quantities of 3 grms., an hour was necessary.

In the course of actual analysis, the oxalate being upon a filter, as much as possible of the substance should be detached from the paper and treated as above described, while the filter itself is burnt upon the lid of the platinum or porcelain crucible, the minute residue left treated with one or two drops only of strong solution of ammonium carbonate, which small quantity can be dried up quite quickly and easily on a water-bath or gently heated sand-bath, and the cover then introduced into the cast-iron cylinder along with the crucible; the two to be taken out, cooled, and weighed together.

(2). *Analysis of Atacamite from Australia.* By Mr. J. A. CABELL, of Richmond, Virginia.

In Dana's "Mineralogy," 5th edition, p. 121, the formula assigned to atacamite is—

$$3\dot{C}uH + CuClH$$

(old atomic weights of copper and oxygen), or 3 molecules of cupric oxide, 1 of cupric chloride, and 4 of water, the author remarking that one or two analyses give one-half more water. Rammelsberg ("Handb. d. Mineralchem.," s. 191) makes three varieties of the mineral, each containing 3 molecules of cupric oxide and 1 of the chloride, but therewith 3, 4½, and 6 molecules of water respectively.

In view of this discrepancy of results as to the amount of water, and there seeming to be no recorded analysis of Australian atacamite, a portion of a very fine, well-crystallised specimen, of rich dark green colour, from South Australia, was placed in the hands of Mr. Cabell for analysis. Sp. gr. of mineral = 4·314. The following were the results, neglecting traces of insoluble siliceous residue, ferric oxide, and alumina :—

	Found.	Calculated.
Cupric oxide	56·64	55·85
Copper	14·67	14·87
Chlorine	16·44	16·63
Water	12·02	12·65
	99·77	100·00

The figures in the last column are calculated from the formula—

$$3CuH_2O_2 + CuCl_2, \text{ or } Cu_2\begin{cases} Cl \\ (HO)_3 \end{cases},$$

which probably represents the composition of normal atacamite, while the larger proportions of water found in some of the recorded analyses may perhaps be due to alteration.

The water was determined *directly* by Mr. Cabell, and the facts carefully established that it had all been driven off and that no chlorine had been volatilised.

I myself obtained some years ago, from a specimen of clean, sandy atacamite from Chili (Rammelsberg, "Handw. d. Ch. Th. d. Mineral.," 5 suppl., s. 57).

Cupric oxide	55·94
Copper	14·54
Chlorine	16·33
Water	12·96
Quartz	0·08
	99·85

numbers agreeing well with the above results.

(3). *Analysis of Bournonite.* By Mr. C. E. WAIT, of Little Rock, Arkansas.

Choice fragments of beautifully crystallised bournonite, from Herodsfoot Mine, near Liskeard, in Cornwall, of sp. gr. 5·826, gave, on analysis—

Sulphur	19·359
Arsenic	0·460
Antimony	23·577
Lead	41·949
Copper	13·268
Iron	0·679
	99·301

eading to the recognised formula for the species—

$$\left.\begin{matrix}Cu_2\\Pb_2\end{matrix}\right\}S_3+Sb_2S_3,$$

the only noteworthy point being the replacement of a little of the antimony by arsenic. This does not seem to have been before observed for bournonite, although so common in other minerals containing the sulphides of these metals. The perfectly crystallised condition of the specimen examined negatives the idea of an admixture with tetrahedrite.

(4). *Analysis of an Iron Slag of Fine Blue Colour from Barrow Iron Works, Lancashire (England).* By Mr. J. R. McD. Irby.

This slag was very compact, tenacious, and hard—declared by a lapidary to be fully equal in hardness to the most refractory jasper; fracture splintery and imperfectly conchoidal. Its colour was a remarkably fine blue, quite comparable with the darker varieties of *lapis lazuli*, so that a specimen cut *en cabochon* made a handsome stone for a finger ring. Sp. gr.=2·883. When reduced to an impalpable powder, it was completely decomposed by strong hydrochloric acid, with loss of colour, evolution of hydrogen sulphide, and separation of flocculent silica. It was ascertained that none of the sulphur present existed in oxidised form. Analysis gave—

		Quotients on dividing by Molecular Weights.
Silica	46·683	0·778
Alumina	5·769	0·056
Ferrous oxide	1·208	0·008
Manganous oxide	1·062	0·007
Lime	39·168	0·699
Magnesia	0·987	0·025
Sodium oxide	1·276	0·021
Potassium oxide	0·967	0·010
Sulphur	2·074	0·065
	99·194	

The ratio of the oxygen in the bases to that in the silica is about 6 : 10, the slag approximating to a simple metasilicate of calcium. While the general composition is quite different from that of *lapis lazuli*, the resemblance in colour and reaction with hydrochloric acid strongly suggest the probable presence of the same or an analogous compound of sulphur with the one to which the fine blue tint of that mineral is generally ascribed. There is enough of the alkaline metals present to allow of the existence of their sulphides, according to the older view of the constitution of *lapis lazuli* and ultramarine, and more than enough aluminium for its sulphide assumed by Stein to be the cause of the colour

(5). *Analysis of a Siliceous Crust on the Surface of Decomposing Obsidian from the East Side of St. Castagna, Lipari.* By Mr. J. A. Cabell.

A light grey obsidian, exposed to the action of heated sulphur dioxide, air, and vapour of water, had been decomposed to the depth of 10 to 12 m.m., producing a white, opaque, porous mass, on the outside of which a delicate, warty, and vesicular crust of 5 to 10 m.m. appeared, resembling hyalite, quite colourless, most of it transparent, some portions slightly milky.

This outside transparent crust was the subject of examination. Sp. gr. (in powder)=2·062. Dissolved to the extent of one-third its weight by boiling for three minutes with solution of caustic soda (20 per cent sodium hydrate).

After drying at ordinary temperature over sulphuric acid, from which no material loss of weight resulted, analysis afforded—

Silica	93·46
Alumina	0·37
Lime	0·74
Ferric oxide	0·37
Ferric chloride	0·15
Water lost at temp. above 100° C.	4·55
Water lost at 100° C.	0·08
	99·72

The mineral is, therefore, opal silica—fiorite or siliceous sintra. The trace of chloride of iron comes in quite naturally from its volcanic origin. The amount of water retained after drying at 100° C. agrees very closely with the results of Gottlieb's experiments (*Journ. Prakt. Chem.* [2], vol. vi., 185-196) upon hydrated silicic acid artifically prepared by decomposition of silicon fluoride.

(6). *Analysis of "Novaculite," or "Ouachita Whetstone," from Hot Springs, Arkansas.* By Mr. C. E. Wait.

A very pure, snowy white specimen of this beautiful material, which has been fairly described by Dr. D. D. Owen in his "Second Geological Report on the State of Arkansas, as "equal in whiteness, closeness of texture, and subdued waxy lustre, to the most compact forms and white varieties of Carrara marble," of sp. gr. 2·649, proved to consist of—

Silica	99·635 (by diff.)
Alumina	0·113
Magnesia	0·087
Sodium oxide	0·165
Potassium oxide	trace
Iron	trace
	100·000

The silica, or at any rate nearly all of it, appears to be in the crypto-crystalline, not in the amorphous or opaline form, as on boiling for three minutes with a 20 per cent solution of sodium hydrate but 1·63 per cent of the mineral was dissolved, and thirty minutes' boiling only led to 3·56 per cent being taken up.

(7). *Analysis of Electric Calamine from Wythe County, Virginia.* By Mr. J. R. McD. Irby.

This mineral was from the land of the late Mr. David Graham, on New River, about 10 miles above the point where it is crossed by the Atlantic, Mississipi, and Ohio Railway. It occurred in irregular masses, for the most part made up of contorted sheets 6 or 8 m.m. thick, botryoidal, and slightly stained by ferric oxide on the outer surface; pure white and nearly opaque, with radiated structure within; hardness, a little over 5; sp. gr., 3·338 at 21° C. It slowly and imperfectly gave up its water at 100° C.

In powder, and moistened with water, it dissolved easily in dilute hydrochloric acid in the cold, the solution gelatinising on standing. With strong acid, it formed a jelly at once. Acetic acid also dissolved it in the cold.

Analysis gave, for the pure mineral previously dried over sulphuric acid at ordinary temperature—

		Calculated for $Zn_2SiO_4+H_2O$.
Silica	23·949	25·00
Zinc oxide	67·883	67·50
Water	8·133	7·50
	99·965	100·00

Hence a calamine unusually free from traces of foreign substances, but with a very slight excess of zinc oxide and water.

University of Virginia,
Sept. 12, 1873.

ON THE ENERGIES OF THE IMPONDERABLES,

WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 238).

TELEGRAPHY seems at present to have taken the most important position in the manifestation of the energy of electricity. Telegraphists therefore naturally consider how they can measure the energy with which they deal. If there are any connected with telegraphy present, perhaps they will remember that this is not a lecture on the present advanced state of telegraphy, nor on modern instruments; it is simply an attempt to make as clear to a general audience as is in the lecturer's power the principles which govern the uses and measurements of electricity in relation to telegraphy. To enter into details in reference to those laws which the electrician and mathematician have been enabled to propound, would be not only very injudicious, but very unsatisfactory. A sketch of the broad principles on which they are founded, and an illustration of the application of them, may prove more useful than an attempt to show how details of measurement have been accomplished.

The first question that presents itself is what may be called the measure of resistance. It was soon observed that electricity passed along certain metal wires more freely than other metal wires of the same size and length. The observation admitted of a very important utilisation. For example, suppose the wire now stretched from one end to the other of this room was one mile in length, and that the little apparatus with which electricity is being produced at this end could produce a certain result at the other end. Now, let us take another metallic wire of the same length, and suppose the result produced in this case is much less than in the first. It will be admitted, without any detailed experiment, that by shortening again and again, the second wire may be reduced to a length which permits the phenomenon at the end of the first wire to be repeated at the end of the second. Now measure the second; it is only one quarter of a mile. Try a third and a fourth wire; perhaps they are respectively reduced to one-eighth and one-tenth of a mile. Evidently there is some property in these wires which hinders, retains, or resists the progress of electricity. The property is called "resistance," and is available for very useful purposes. The British Association for the Advancement of Science were so conscious of this that, in 1861 and 1862, there were grave considerations as to what steps should be taken in order to assign a value to this resistance. You have seen how the quantity of electricity may be measured, but then that measured quantity had not to convey itself to a distance. It quietly, as it were, stayed at home and worked. When telegraphy entered then electricity had to travel to or act at a distance. This state of affairs rendered it very desirable to determine "resistance," from what is called first principles, that is to say, to deal only with the three units of measurement, mass, space, and time. It was needful, by some means or other, to get this resistance into the form of mass, space, and time. It was considered that if we could regard it as velocity we thereby involved both space and time, because velocity is measured by space and time. If one runs a mile in an hour, then it is only needful to divide one mile by sixty minutes, and the space run in one minute is known. That would be the measure, assuming the minute to be the unit of time. The British Association appointed a committee. The chief gentlemen concerned in the committee, and who had the designing of a mode of grappling with one of the most critical tasks of science, were Mr. Clerk Maxwell, now Professor of Physical Science at Cambridge, Mr. Balfour Stewart, of Kew Observatory, now at Manchester, and Mr. Fleeming Jenkin, now Professor of Engineering in the University of Edinburgh. Their experiments were carried on in King's College, and the scheme now to be very briefly described is found in the report of the British Association for 1863.

It may here be remarked that perhaps there have been no lectures ever given in this room of a more important and scientific character than a course of Cantor lectures on electricity by Mr. Fleeming Jenkin. This course commenced in January, 1866, and will be found reported in the *Journals* published between the 2nd February and 2nd March, 1866 (inclusive). It is well to make further statement, that those lectures have frequently been appealed to by writers on electricity who regarded the phenomena thereof in the light of an accurate science.* The question, then, is, how are we to measure in velocity this resistance? How are we to convert that which is resistance in a wire into an electrical measure of velocity? [The lecturer here, by apparatus and diagrams, illustrated the principle upon which this mode of measurement was based, and in so doing referred to the currents passing through the room as already described.] At Kew there is a record of these currents kept continuously night and day, and it is found that they are changing every minute. The main object, then, of the committee of the British Association was to devise a plan by which they could ascertain the resistance that a given wire offers measured by comparison with the velocity of these currents. You may remember that Kater could not measure the law of gravity, owing to the fact that it was rapid in its actions, and he felt that he must have some means of causing that law to repeat itself. Kater adopted the pendulum, and recorded the number of times it oscillated in twenty-four hours, and thereby got at the law. If, instead of having a long wire and three others running along the bar, as in the apparatus before you, we had a ring of this kind, and caused that to revolve rapidly, say at the rate of 100 or 200 or even 1000 revolutions in a minute, we still get the laws of the magnetic force in the same way as described, similar to when the bar passed along the rods before you. This causes the magnetic force to act upon the needle, and in reality, in the experiments which determined what is called "the British Association unit of resistance," these currents acted upon a very small needle carefully suspended, so that they were enabled to estimate the resistance of this wire in an absolute measure of space and time. That led to the adoption of what is called the "ohm," or "British Association's unit of electrical resistance." This term "ohm" is a name given in compliment to one who suggested an important relationship among the elements of current, force, and resistance. Indeed, that table of electrical measurements which may some day be placed in books of arithmetic, with corresponding tables of weights, measures, and money, will be found to contain the names of men who have investigated special departments of electrical science, such, for example, as Ohms, Farads, Volts, Webers, &c.

In this little glass cylinder there is a coiled length of German silver wire, German silver being used because it possesses great resistance to electrical currents, and that resistance does not change much with change of temperature. This coil constitutes what is called half a British Association unit, which becomes the measure of electrical work, just as the standard pound becomes the measure for weight, or the foot is the standard measure for length. Being possessed of this measure, we have all that is needful for the measurement of resistance, and

* The Cantor Lectures, delivered before the Society of Arts.

* Since the commencement of the publication of this course of Cantor lectures, a volume has been issued, entitled "Electricity and Magnetism," by Fleeming Jenkin, published by Longmans and Co., price 3s. 6d. In this volume the author has treated the subject in a novel and a practical manner, very different, indeed, from ordinary text-books on electricity. It will be found to contain matter of great value and interest to the thoughtful student of electricity

therefore for measuring electrical work connected with telegraphy.*

To show the way in which a knowledge of this measurement can be utilised, rather than to enter upon those investigations by which it was obtained, seemed likely to win so much more attention and interest that these arrangements before you are for this purpose. The intention is to show how electricians determine the distance at which a deep sea cable is broken, so that they can tell how far the fracture is from the shore. Let it be understood that it is the illustration of a principle, and not the nature and modes of dealing with different kinds of "faults," that are to be our concern.

There is a wire, which may represent a cable, round the room. In this box there is placed a number of "ohms" arranged in three sets of nine each, so that by moving these pegs a current of electricity can be caused to pass through either one or more of them. Assuming each "ohm" in the first set to represent one resistance, each in the second set ten, and each in the third set one hundred, the consequence is that, if a current of electricity passes through all, it would meet with a resistance of 999. If it passed through one of the first set, it would only be one resistance; so that, with the moving of these brass pegs, there is the power of bringing in any number of ohms required. This flat board, about 3 ft. 6 ins. long, with a German silver wire and broad bands of copper divided at intervals, but capable of being put into electrical connection by the insertion of pieces of metal, constitutes what may be called the beam of electrical scales. Resistance, however, is to be measured instead of weight. Along a wire at the back, electricity can pass, and, when connected with the galvanometer, the speck of that instrument serves the same purpose as the pointer of a pair of scales. If the galvanometer speck points to nothing, we assume that there is equilibrium between the resistances at each end of the scale beam. If I put 999 "ohms" in what we may call one scale, and other resistances into the other scale, or that which we may consider as such, then, if the current of electricity, arranged as provided, can pass one of these groups of resistances more freely than the other, the speck of light will be moved. This is the same as though one end of a scale beam were "kicked up." Therefore, resistances, which in this case act the part of weights on ordinary scales, must be taken out or added as may be required.

This wire running partially round the room represents a cable. The two ends of this cable are in my hand. Let us assume that we want to measure the resistance the cable opposes to the energy of electricity, and to ascertain the value of its opposing power. Here is what is usually called a battery, consisting simply of a little salt and water, in a very small tumbler glass. "Battery" is a very misleading name in these days. This, with all its belongings, is really not worth sixpence, and it certainly seems a piece of pedantic magniloquence to call it a "battery."

The wires from this battery are so arranged that the current may divide itself between the cable that is round the room and this box of "ohms."

It may perhaps make the illustration more intelligible to those who have not familiarised themselves with terms of electrical science if for a while this current be regarded as consisting of passengers. Let it be represented by 100 passengers setting out from this battery, and having the choice of two routes, viz., one by the cable, and one by this box of ohms.

If the two routes are equally free, *i.e.*, offer equal resistances, then fifty of these passengers will pass by one way and fifty by the other. Suppose that the resistance of one route (say the cable) is greater than that by the other route. Then that other route, or the way through the box of ohms, will be available for some of those passengers who cannot readily pass by the cable. Here is a wire connecting these two routes; indeed the large letter A may convey a clear idea of the plan. Consider what is likely to happen if fifty of these electrical passengers set off from the top of the A down the thick stroke, and fifty down the thin stroke. We may say that those passing down the thin line cannot pass so freely as those down the thick one. Hence, finding the course down the thick line clear, some of these delayed passengers by the thin line may avail themselves of this cross-wire bridge, viz., the stroke in the A, and go to the place appointed for them by passing down the thick stroke. In this homely illustration the thin stroke is the cable—the thick stroke is the box of ohms. Clearly by moving these brass pegs, the resistance in the box of ohms is increased; that is, the thick stroke of the A is made more nearly the same as the thin stroke. Now introduce into this cross-way—this bye-path, as it were—the galvanometer. Then if any electrical passenger avail himself of this bye-road, the bright speck of light will tell the tale, and by noticing whether the speck moves to the right or left, the direction in which the passenger travelled is known, and therefore the electrical pathway which offers the greatest resistance is also known. By moving the pegs in the box of ohms, an equality of resistance may be established, and then passengers will not pass along the bye-way through the galvanometer; therefore the speck of light will not move.

Nor is this indication of an electrical traveller the only use which may be made of the galvanometer speck. You are aware that the extent of deviation of this needle is the measure of the quantity of electricity in transit; therefore the extent of deviation tells the number of passengers; in fact, the galvanometer becomes an electrical tell-tale turnstile for counting the number passing through, and so indicating or measuring the difference in resistance between the two courses.

Let us leave this figurative mode of expression. In the experiment before you the pegs in the box of ohms read 505; the speck of light is steady; therefore we know that the entire length of cable, of which the two ends are here, also offers a resistance of 505. Before this cable was laid a comparison with these ohms had been instituted, and it was found (say) that one mile of the cable offered a resistance to the passage of electricity equal to one ohm, therefore there are 505 miles of cable, because there are 505 ohms.

Now let us break the cable by cutting the wire. There! one end has fallen to the bottom of this large pan of salt and water. This pan must, for the present, be looked upon as an Atlantic Ocean, one end of the cable is at the bottom of it, and we wish to know how far from the end in my hand the separation has taken place. To compensate for the portion of the cable hitherto used, but now detached, the earth is available; this sheet of copper, in and on the shore of our Atlantic Ocean, is buried. Soldered to the copper is a wire, of which the end is in my hand.

There are therefore in my hands the ends of two wires; one, that of the broken cable—the other, that connected with the buried sheet of copper. Let us deal with them as we did with the complete cable. [After various trials the pegs in the box of ohms were so arranged that the speck of the galvanometer was steady.] The speck is now steady, and the pegs read 350. This means that there are 350 miles of cable, or its equivalent. Now, the cable and the earth are the only elements on the one side; and since the earth is as a large reservoir of electricity it offers no appreciable resistance; hence the only resistance is that of the broken cable. The length of this is pointed out as 350 miles; this, therefore, is the distance of the fracture from the shore.

It is, perhaps, superfluous to state that many circumstances arise differing from those described, and many precautions have to be taken to which no allusion has

* Those who are disposed to give the thought and application requisite for a clear comprehension of these principles of electrical measurement may refer to chapters ix. and x., extending from page 147 to page 165, in Jenkin's "Electricity and Magnetism."

been made. If, however, the general principles be made clear, that is accomplished which was intended to be done, and those who are desirous of further information may consult the higher class of books which treat on practical telegraphy. It may be of some interest to let you see how delicate and perfect a test even this loaded galvanometer speck is. One or two illustrations will show how electrical currents are set in action when we are at least aware of them.

Here is a small piece of zinc, like the blade of a penknife, attached to one end of a wire passing round the galvanometer, and here is a piece of copper attached to the other end. The zinc is now pushed into this apple. Observe, the speck moves so soon as the copper enters the apple. Repeat the experiment with a potato; the same phenomenon takes place. The potato forms a very good battery. There is another mode that is really more extraordinary still. If the galvanometer were sensitive, it is no fiction to say you can send a kiss across the Atlantic. Here are two little bits of zinc and copper attached to the ohms and cable combined as one length, and the galvanometer is now in circuit with them. If I kiss these two ends, the speck moves. Therefore, that mysterious something which is called electricity, and which has its origin at the lips, has exerted an energy sufficient to move the needle; indeed, sufficient to travel by the cable from one side of the Atlantic to the other, and move a needle when it arrives there.

Again, here is a small beef-steak and a knife and fork. These latter are connected by two thin copper wires with the galvanometer. One wire is attached to the blade of the knife, and the other to the prong of the silver fork; by watching the speck, you see that even one mouthful of meat cannot be cut without causing a current of electricity quite sufficient to manifest itself on the other side of the Atlantic.

Thus, surrounded by ever-active phenomena, which seem to have escaped the notice of men until the present age, he would indeed be more bold than prudent who ventures to speak confidently of what may or may not be done by one or other of the energies of the imponderables. How novel and delicate are the instruments employed, how accurate are the uses to which electricity has been applied; yet these are not consequences of a blind rule-of-thumb following of that which has been long known. Patient research, persevering labour, and much thought have not only "put a girdle round the earth," but they promise fair to enter upon and possess electrical territories of vast extent and luxuriant social fertility. When will the people of England recognise this? Echo answers, "When!"

(To be continued.)

CORRESPONDENCE.

PUBLIC ANALYSTS.

To the Editor of the Chemical News.

Sir,—I should like to ask chemists whether they think that the remuneration given to Public Analysts is sufficient in most cases, either to induce men of ability to undertake the duties, or to induce young men at college to study that branch of chemistry with a view of filling the post of Public Analyst. My opinion is that it is not; the fees and salaries paid, either or both, as the case may be, are miserably low in the extreme; and no man could undertake the duties who has not other means of making a comfortable living, and such being the case it is evident that he can give but a small portion of his time to the duties connected with his office. Hoping to hear the opinions of some experienced chemists,—I am, &c.,

P. S. G.

ALUM IN BREAD.

To the Editor of the Chemical News.

Sir,—In an editorial postscript to a letter in the Chemical News, vol. xxviii., p. 262, you promise an article on the detection of alum in bread. As in the letter to which your note is appended reference is made to what is termed the "Shoreditch Case," I trust that you will not hastily assume the truth of the incorrectly-reported, and *ex parte* statements which have been published of the proceedings at the Shoreditch Vestry with respect to the analysis of bread.

Till the Select Committee has reported on the allegations made against me, I may fairly assert that no *proof* has been as yet forthcoming that I have had any bread adulterated with alum sent to me for analysis from Shoreditch.—I am, &c.,

The Shoreditch Analyst.

November 22, 1873.

[We have also received a letter from Prof. Gardner on this subject, which, however, arrived too late for publication.]

IRON IN TEA.

To the Editor of the Chemical News.

Sir,—In the Chemical News, vol. xxviii., p. 259, there appeared an article by Mr. W. Mattieu Williams on "Iron Filings in Tea," and as a public analyst who has devoted some attention to the tea question, I regret that I differ materially from Mr. Williams on some points.

It appears to me that your correspondent has formed his opinion wholly from what he has read, and has not personally examined any of the so-called "iron filings" from tea. I have come across several specimens of tea containing genuine iron filings, soluble in nitric acid with effervescence (magnetic oxide is scarcely soluble in nitric acid), and in one instance found real *lumps* of metal.

Thus it is a mistake to suppose that the metal is always introduced as *filings*, and I am surprised that Mr. Williams, with his Sheffield experience, should lay so much stress on the trouble of obtaining finely-divided iron. I have no doubt I could beg a hundredweight to-morrow. Still there is little doubt that in some instances the magnetic matter has consisted of the native oxide, and I have at the present time a tea under examination which contains the iron in this very form. But, remembering the refractory character of native magnetite or hæmatite, it seems very improbable that it would be appreciably acted on by a weak vegetable acid like tannic acid, though the hydrate formed by the rusting of introduced metal would readily react.

But the difficulty of introducing iron filings or borings is considerably over-rated. If it pays to introduce from 3 to 8 per cent of quartz pebbles, as large as the V of the "Vol." on the title-page of the Chemical News, and to roll them up in the interior of tea leaves, as seems to be the usual practice with low-class "capers," it would surely answer with iron, which has a higher specific gravity and possibly some chemical action. We can understand the tea plant to become dusty, as our gooseberry and currant bushes do in England, but that 5 per cent of little stones could adhere to the leaves throughout the process of picking is incomprehensible.

Mr. Williams appears to consider that an addition of 5 per cent of a substance not injurious to health ought not to be considered an adulteration. But if a half-crown tea contain 5 per cent of stones, the purchaser pays 1½d. for rubbish, and is certainly defrauded to that amount. In many businesses the seller is content with 5 per cent profit.

But the iron is not always present in the metallic state or in the condition of native oxide. In several instances I have found considerable quantities of soluble iron com-

pounds, no doubt added as a "dye," as Mr. Williams would probably call it. Now the popular judgment of the strength of a tea being founded on the depth of colour possessed by the infusion, the effect of the addition of sulphate of iron is to give the tea a fictitious *strength*, and seems as unjustifiable an addition as that of cayenne to give a sulphuric acid to vinegar. In addition to this, the habitual drinking of strong chalybeate water is very unsuitable to most constitutions.

It is usual to credit the Chinese with the adulteration of tea, but I am much inclined to think that in some instances we should look nearer home.

The addition of sulphate of iron to tea is an adulteration of so eminently scientific a character that one is led to suspect the "dyer" to have belonged to a nation more highly civilised and alive to the advantages of applied science than the "Heathen Chinee" is generally supposed to be.

The difficulties which public analysts have had to contend with have been very considerable, owing to the want of definite and reliable processes for the detection of certain adulterations of tea, and the absence of sufficient data as to the composition of genuine teas.

Mr. Wanklyn has given us valuable information as to the ash of tea, and I have myself obtained more exact determinations of the percentage of tannin and theine, and so, as the necessity arises, the other doubtful points will no doubt find a solution; but during the attainment of analytical perfection the want of more definite information will prevent the detection of many cases of adulteration, and thus give a dishonest tea-dealer the advantage.

It is certainly much to be regretted that so many of the analysts appointed under the new Act are men to whom it would be useless to look for help in the elucidation of obscure questions, and it seems that we may even have bungling in cases where a mistake appeared impossible; but I think if chemists will look back on the work of the past year, they will find that the public analysts have given them valuable original information on many points, including milk, butter, and tea.—I am, &c.,

ALFRED H. ALLEN.

Borough Analysts' Laboratory,
Sheffield.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of sulphate of soda and sulphate of potassa. James Hargreaves, Widnes, Lancaster, chemist, and Thomas Robinson, iron founder, of the same place. February 22, 1873. —No. 680. This relates to the production of sulphates by our direct action method. (1). Sulphates are mixed with the chlorides previous to the mass being broken into pieces. (2). Solutions of salts of copper, zinc, manganese, or chromium, are added to the chlorides, preferably before the mass is dried, and broken into pieces. (3). Steam or atmospheric air is employed to displace the gases contained amongst the converted finished sulphate.

Improvements in the purification of syrups and sugar. Alexander Melville Clark, patent agent, 53, Chancery Lane, Middlesex. (A communication from Louis Joseph Frédéric Margueritte, of Paris.) February 22, 1873.—No. 682. The invention relates:—(1). To the purification of syrups from beet-root, cane, or other sugar, by the action of acids on the saccharine juices in a boiling state, either in a vacuum or otherwise. (2). To the treatment of saccharine juices for extracting crystallisable sugar therefrom, preferably by the aid of sulphuric or hydrochloric acid, by boiling in a vacuum at a low temperature. (3). To the use of like means for purifying molasses. (4). To improving first, second, and third quality sugars by like means.

Improvements in the composition of artificial marbles, stones, and cements of every kind, in making them firmer, harder, less absorbent, and more able to bear exposure to air, water, and other influences, than hitherto, which improvements are applicable to the making of paints, and as a substitute for leather and other like fabrics." Samuel Rowbotham, operative chemist, 24, Leighton Road, Kentish Town, London, and George Richardson, Chignal Hall, Chignal St. James, near Chelmsford, Essex. February 24, 1873.—No. 684. The use of albumen in mixing with plaster of paris or other substances, and its coagulation by heat, or by any other means capable of effecting such coagulation.

An improved method of obtaining photometric measurements, and apparatus for that purpose. Major Francis John Bolton, 21, Grosvenor Mansions, Westminster, Middlesex, and Major Charles Edmund Webber, R.E., 91, Cornwall Gardens, Kensington, Middlesex. February 24, 1873.—No. 686. This invention relates to a method of and apparatus for obtaining photometric measurements in terms of electrical measurement. A body, of which the electrical conductivity or resistance is altered by exposure to light, is placed in an electrical circuit, in which circuit is also placed an electrometer or gauge of electrical resistance. Light is directed on the body, and the value of this light, or the transparency or density of any translucent substance through which the light is passed is tested by the effect on the electrometer or resistance gauge.

Improvements in boiling wood or other fibrous material for the manufacture of paper, and in the treatment of the waste lyes. James Abraham Lee, Severn Engineering Works, Lydney, Gloucester. February 24, 1873.—No. 695. This Provisional Specification describes the use of an exhaust pump to discharge the air contained in the material, and so replacing it with caustic solution. Also the addition to spent lye of acetic acid to form a valuable product and solid residue. Also the addition to spent lye of other acids, with a similar object.

An improvement in the manufacture of candles, matches, and other like articles, together with a lamp or apparatus for burning such candles. Alexander Melville Clark, patent agent, 53, Chancery Lane, Middlesex. (A communication from W. J. S. Grawitz, Paris.) February 25, 1873. —No. 703. This invention relates to the application of naphthaline—(1). As a substitute for sulphur, wax, resin, or other inflammable materials used for dipping or impregnating matches and firelighters. (2). As an addition to the phosphorus paste in which the ends of wax and other matches are dipped. (3). To increase the inflammability of candles, tapers, links, and torches. (4). For burning in lamps in the form of a hollow candle, provided with an independent wick and double air current, the flame serving to melt the solid naphthaline to feed the wick.

An improved mode or process of preserving meat. Eugène Metge, and Félix Nicolas Cyprien Vuibert, both of Boulogne-sur-Mer, France. February 26, 1873.—No. 710. This invention relates to a method or process of preserving meat in bulk in its fresh, uncooked condition. The animal is killed by felling, and immediately skinned and cleaned. It is then glazed over with a preparation of sugar and alcohol and placed in a case in a bed of fat. The case is exhausted of air and soldered up.

Improvements in the manufacture of size. Robert Kay Whitehead, bleacher, Walmersley, near Bury, Lancaster. February 28, 1873. —No. 743. The object of my invention is to prevent mildew in yarns, woven fabrics, and other fibrous substances or materials, and it consists in combining a certain quantity of mustard oil or other vegetable oil possessing similar antiseptic properties, with the farinaceous or other size, which is applied to the yarns, woven fabrics, or other fibrous substances or materials for the purpose of stiffening them.

An improved artificial fuel. Thomas Cadett, Rosherville, Kent. February 28, 1873.—No. 744. Peat, turf, or bog is combined either with tar, pitch, resin, asphaltum, or other resinous or bituminous substance, or with oil. The peat or turf is first dried by exposure or by artificial heat, and is then immersed in one or other of the above substances and submitted to pressure in moulds, to thoroughly impregnate it with the tar or other substance and express any superfluity. After being again dried it is fit for use.

NOTES AND QUERIES.

Removing Black Dye.—If any of your subscribers could give me the best and cheapest way to remove the black dye from worsted that has been dyed black, they would confer a favour.—A. *Z.*

Orchil.—I should be very glad if any of your correspondents could favour us readers of the CHEMICAL NEWS with an article on the manufacture of orchil. I have taken your valuable paper a long time now, and have never seen it mentioned. It is becoming an important manufacture in Leeds, for in 1860 there were only three works, and now there are eight works, employing nearly 200 hands.—A POOR WORKING LAD STRUGGLING FOR INFORMATION.

The Estimation of Sulphur in Pig-Iron.—In the explanation of the "simple and ready" method described by me in the CHEMICAL NEWS, vol. xxviii., p. 248, I do not perceive any claim to absolute originality; but that it was worthy of note is proved by the fact that it found place in the columns of the CHEMICAL NEWS. Persons using chemical processes by rule-of-thumb, as is generally the case in metallurgical laboratories, probably do not test the purity of their reagents, from whence, doubtless, arises the discordance of their results.—CHARLES H. PIESSE.

MEETINGS FOR THE WEEK.

MONDAY, Dec. 1st.—Royal, 4. Anniversary.
—— Royal Institution, 2. General Monthly Meeting.
—— Medical, 8.
—— London Institution, 4.
TUESDAY, 2nd.—Civil Engineers, 8.
—— Photographic, 8.
—— Anthropological Inst., 8.
—— Zoological, 8½.
—— Anthropological, 8.
WEDNESDAY, 3rd.—Society of Arts, 8.
—— Geological, 8.
—— Microscopical, 8.
—— Pharmaceutical, 8.
THURSDAY, 4th.—Chemical, 8.
FRIDAY, 5th.—Geologists' Association, 8.

SUPPLEMENT
TO
THE CHEMICAL NEWS.
VOL. XXVIII. No. 731.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 20, 1873.

Dr. ODLING, F.R.S., President, in the Chair.

THE names of the visitors having been announced, and the minutes of the previous meeting read and confirmed, Messrs. John Turner and G. Bulk Francis were formally admitted Fellows of the Society.

The following names were read for the first time—Messrs. Edward H. Davies, Sydney Trivick, John Smyth, M.A., Edmund Richard Southby, Edward Daniel Stone, John Sutherland, Carl Schorlemmer, F.R.S., and John Clement Smith.

For the third time—John Douglas, Esq., who was ballotted for and duly elected.

The first paper, "*On the Coefficient of Expansion of Carbon Disulphide*," by J. B. HANNAY, was then read by the Secretary. It contains the results of a numerous series of determinations of the specific gravity of carbon disulphide at small differences of temperature made in an apparatus of peculiar construction, so as to prevent evaporation, and to admit of the subsequent expansion of the liquid when adjusted at low temperatures. When the apparatus was carefully cleaned, the disulphide could be heated in it considerably above its boiling-point, thus affording a means of obtaining its specific gravity at comparatively high temperatures. The temperature of the specific-gravity bulbs was adjusted by immersing them in water kept at a constant temperature by a modified form of Carmichael's apparatus. Two tables of the calculated and observed variation from 0° to 62° C. in the volume and specific gravity of the disulphide, the latter referred to water at 4°, accompany the paper. From the results the author concludes that carbon disulphide expands equally for each equal increment of temperature, the number denoting the coefficient of expansion being 0·001129, and that denoting the decrease of specific gravity 0·001461 for each degree Centigrade.

The PRESIDENT said the thanks of the Society were due to the author for his communication, and also for the new form of specific-gravity bottle he had introduced to their notice.

Dr. MILLS remarked that, if the coefficient of expansion of carbon disulphide were the same for a considerable range of temperature, it would differ in that respect from every known liquid, as their expansion was represented by a function of the third degree. The speaker had had some experience in working with delicate thermometers, and would like to ask how the temperature was determined. It was well known that the zero point of new instruments varied considerably from day to day, so that, although an accurate determination might be made with the corrected thermometer to-day, at the end of a week there might be a comparatively large error if the same correction were employed. In determinations giving such abnormal and extraordinary results, he details of the thermometric corrections should be given.

Professor G. C. FOSTER pointed out that the author had stated that the specific gravity of the liquid diminished by a constant number for each equal increment of temperature; now, if this were true, it was obvious that equal decrements of specific gravity would not give equal increments of volume, and it was therefore impossible that the expansion should be constant; there must be some error in the calculations.

The SECRETARY said no details were given in the paper of the precautions taken in determining the temperature.

A paper, "*On the Action of Hydrogen on Silver Nitrate*," was then read by the author, Dr. RUSSELL, F.R.S. He finds that thoroughly washed and purified hydrogen causes a precipitate of metallic silver from a solution of silver nitrate, the precipitation occurring much more readily in saturated than in dilute solutions. The gas employed was usually procured by the action of a saturated solution of copper sulphate on zinc, or by the action of water on a mixture of powdered zinc and tin; after it had been passed for about half an hour through a saturated solution of the silver salt, a dull greyish deposit is produced, which is succeeded by a bright crystalline precipitate. This precipitation is quite independent of the action of light, but is increased by heat; a clear solution, through which hydrogen had been passed for a minute, became turbid, and gave a precipitate of silver when heated. Similar effects were obtained when the solution was exposed to an atmosphere of hydrogen, instead of causing the gas to bubble through it. The author has conclusively proved that these phenomena are caused by the hydrogen displacing the silver in the silver nitrate, producing hydric nitrate, but a secondary reaction also takes place between the nitric acid and the precipitated silver, resulting in the formation of silver nitrite, and, as silver nitrite is not decomposed by hydrogen, the end product formed would be silver nitrite. Dilute solutions of nitric acid have little or no action on metallic silver, so that hydrogen precipitates silver as readily in a solution containing 7 per cent of nitric acid as from an aqueous solution; on the contrary, even very dilute nitric acid, if it contains a trace of nitrous acid, readily dissolves the metal. Platinum, palladium, and gold are completely precipitated from their solutions by hydrogen. Copper nitrate is reduced to nitrite, whilst mercuric nitrate deposits a basic nitrate.

Dr. ODLING thanked the author for the very complete manner in which he had investigated this subject of the precipitation of silver by hydrogen.

Professor MASKELYNE said the experiments of Dr. Russell were particularly interesting to mineralogists, and might throw some light on the relation between the circumstances under which the substance was precipitated and its crystalline form, as it was far easier to ascertain facts than to give satisfactory explanation of them; for instance, why did sulphate of barium occur in a particular district crystallised in one set of forms, and in another district in another set of forms? In order to get some insight into this matter, the conditions of the formation of crystals must be carefully observed. He had examined the crystals of silver, and found them to be octahedra; the filamentous form consisted of chains of octahedra.

Dr. C. R. A. WRIGHT had listened to the paper with great interest; when endeavouring to determine the sulphur in iron, by dissolving it in acids, and passing the evolved gas through various metallic solutions—and, amongst others, ammoniacal nitrate of silver,—he had found more silver was precipitated than corresponded to the sulphur in the iron. He would like to ask Dr. Russell whether he had tried the action of hydrogen either on ammoniacal silver nitrate or on the solid nitrate itself.

Professor WILLIAMSON said there was a point of some interest connected with the paper—namely, as to hydrogen being more soluble in a solution of silver nitrate than in pure water. According to Dr. Russell, about half an hour elapsed before the silver began to be precipitated, so that there might be time to ascertain the amount of hydrogen dissolved. As the solubility of hydrogen in water diminishes with rise of temperature, it was conceivable that hydrogen also dissolves less freely in hot solution of silver nitrate than when cold. This would afford an explanation of the precipitation of silver from the solution when it was heated. Supposing the silver is only precipitated when

the solution is saturated with hydrogen, the cold solution, not being saturated, would give no precipitate, but, on heating it, silver would be precipitated as soon as the saturation-point was reached.

Dr. RUSSELL replied that he had not as yet made any determinations of the solubility of hydrogen in nitrate of silver solution. He had also forgotten to say that he had found that, when air was excluded, the product of the action of silver on nitric acid was silver nitrite.

Dr. C. R. A. WRIGHT read a "*Note on the Action of Zinc Chloride on Codeine*." In attempting to prepare apocodeine for the market, according to the process of Matthiessen and Burnside, by acting on codeine with zinc chloride, Mr. D. Brown obtained a product which possessed most of the properties ascribed to apocodeine hydrochloride, but which, when analysed by the speaker, was found to be isomeric with codeine hydrochloride; in fact, at low temperatures, the chief product is a loose compound of zinc chloride with the hydrochloride of the base *tricodeine*, and, if a longer time of heating be adopted, or a higher temperature, *tetracodeine* is also formed. The author thinks that Matthiessen and Burnside's apocodeine was an alteration product, due to the action of hydrochloric acid on the tricodeine first formed.

Dr. ODLING having thanked the author for his communication, a memoir "*On the Chemical Properties of Ammoniated Ammonia Nitrate*," by E. DIVERS, M.D., was read by the Secretary. In this paper the author describes the action of the liquid produced by the deliquescence of ammonia nitrate in an atmosphere of dry ammonia on various elements and compounds, comparing the results with those obtained by Gore with ammonia liquefied by pressure. As a rule, these properties appear to be the result of the joint action of the two constituents of the liquid—namely, ammonia and ammonia nitrate; the latter, as might be expected, considerably modifying the action of the ammonia. The behaviour of the liquid towards upwards of 150 substances was examined, including most of the elements, the metallic chlorides, oxides, and sulphides, also some bromides, iodides, nitrates, carbonates, chromates, &c.

The PRESIDENT having thanked the author in the name of the Society, a note "*On the Analysis of a Meteoric Stone, and the Detection of Vanadium in it*," by R. APJOHN, was read by the Secretary. After alluding to former analyses of meteoric stones, and enumerating the elementary bodies present in them, the author draws attention to the fact that the proximate constituents of meteorites are generally the same as those of trap-rocks, and, since vanadium is found in the latter, it might possibly also exist in the former. An examination of a meteoric stone which fell, in 1810, in the county of Limerick, showed that it contained vanadium. A complete analysis of the stone is given, and the analytical methods employed are described in detail.

After returning thanks to the author, the PRESIDENT finally adjourned the meeting until Thursday next, Dec. 4.

MISCELLANEOUS.

Exhibition of Appliances for the Economic Consumption of Fuel.—Practical and scientific inventions and improvements of all kinds bearing on the solution of the great fuel question are to be afforded the fullest scope for treatment at the forthcoming Exhibition of Fuel-Economising Appliances, to be held by the Society for the Promotion of Scientific Industry. The following comprehensive classes of exhibits are now announced by the Council of the Society:—(1). Appliances which may be adapted to existing furnaces, &c., whereby an improved combustion of the fuel is secured, and a direct diminution in the quantity required is effected. (2). Appliances which may be adapted to existing steam boilers, &c., whereby the waste heat of the flue gases or of exhaust steam is utilised, (3). Appliances which may be adapted to existing steam-boilers, pipes, and engines, whereby loss of heat from radiation and conduction is prevented. (4). Appliances which may be adapted to existing steam-boilers and engines, enabling them with safety to realise the great economy resulting from the use of high-pressure steam or superheated steam. (5). New or improved furnaces (using solid, liquid, or gaseous fuel), boilers, and engines of all descriptions, specially adapted for the saving of fuel. (6). Apparatus which, by producing a cheap and abundant gaseous fuel, will supersede the costly carriage of coal, obviate the present enormous waste attending its use in the solid form, and condense and save the valuable sulphur, ammonia, and other by-products of the distillation, now injuriously affecting iron- and other smelting processes, and, in a vast number of operations, discharged as poisons into the air. (7). Apparatus or engines for obtaining power advantageously from heat through any other medium than steam. (8). Natural and artificial fuels of all kinds. (9). Coal-cutting machines; peat-manufacturing machines. (10). Domestic and other fires, stoves, ranges, and apparatus of all kinds (using coal, gas, or other fuel) for cooking, and for warming rooms and buildings. (11). Mechanical or other arrangements for securing the delivery of proved weights of fuel to the domestic consumer. The Exhibition is to be held in Manchester, and will be opened on December 18th, by the Rt. Hon. the Earl of Derby, F.R.S., President of the Society. In consequence of the large amount of space that has been applied for, the Council of the Society has determined to increase the size of the Exhibition Building, and to include the appliances named in 9, 10, and 11 as above.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, October 20, 1873.

Production of Certain Crystallised Borates by the Dry Way.—M. A. Ditte.—(Continued from page 783.) The author has formed and examined the biborate of baryta, $BaO,2BoO_3$, containing—

Baryta	52·37
Boracic acid	47·63
	100·00

and also the sesquiborate, $2BaO,3BoO_3$, which contains—

Baryta	58·46
Boracic acid	41·54
	100·00

A magnesium salt was obtained, containing—

Magnesia	30·00
Boracic acid	70·00
	100·00

and answering to the formula, $3MgO,4BoO_3$, which corresponds exactly to that of the native boracite of Brunswick occurring in the gypsum which forms interposed masses in the chalk formations. Another compound obtained, $3MgO,2BoO_3$, is analogous to the basic borates of strontia and lime. The neutral salt, MgO,BoO_3, contains—

Magnesia	36·85
Boracic acid	63·15

The author also obtained certain double borates, as a double

borate of lime and magnesia, $(3CaO,2BoO_3)(3MgO,2BoO_3)$. A double borate of strontia and magnesia was found to have the composition, $(3SrO2BoO_3)$ $(3MgO,2BoO_3)$. The analogous barytic compound was not obtained.

Chloro-Vanadiates.—M. P. Hautefeuille.—The reproduction of vanadinite, and the preparation of a Wagnerite containing vanadium, have enabled the author to show that the vanadiates, like the phosphates and the arseniates, form two series of isomorphous salts in combination with chlorides. Vanadinite was formed by heating to dull redness pure vanadic acid intimately mixed with litharge, and with a large excess of lead chloride. After cooling and dissolving out the chloride of lead we obtain yellow transparent needles of a fatty lustre. These crystals, like the natural product, contain 3 equivalents vanadiate of lead to 1 of chloride. The chlorides capable of uniting with the vanadiates when fused are not numerous, the greater part being decomposed by vanadic acid. This is the case with the chloride of magnesium. The chloride of calcium, on the other hand, forms a chlorovanadiate of lime if heated moderately with the needful ingredients. It forms, when freed from excess of chloride of calcium, crystals of a dead white, and of an adamantine lustre. They contain—

Vanadic acid	39·07	1 equiv.
Lime	36 66	3 ,,
Chloride of calcium	23·75	1 ,,
Loss	0·52	
	100·00	

This salt, when crystallised, does not belong to the same type as vanadinite; it is not an apatite, but has the composition of the wagnerites, containing equal equivalents of vanadiate and of chloride.

Mode of Producing Methylamins in the Manufacture of Pyroligneous Products.—M. C. Vincent.—Crude pyroligneous acid saturated with slaked lime before the separation of the methylic alcohol, and submitted to partial distillation, yields crude methylic alcohol; the first portions of which contain ammonia in considerable quantities, and some traces of methylamin. This alcohol, completely saturated with sulphuric acid, deposits a white, crystalline, non-deliquescent mass, insoluble in methylic alcohol, and readily crystallisable from water. If, instead of immediately collecting the alkaline methylic alcohol, it is submitted to rectification in an apparatus furnished with a cohobator, we obtain a product the first portions of which are rendered alkaline by a small quantity of ammonia, and a notable amount of methylamin. This alcohol, re-distilled several times in the same apparatus, contains only traces of ammonia; but, instead, considerable quantities of methylamin, dimethylamin, and trimethylamin.

Theorem Relative to the Movement of a Point Attracted Towards a Fixed Centre.—M. Bertrand.

"Astronomische Mittheilungen" of Dr. Rudolphe Wolf.—M. Faye.—The connection of sun spots with magnetic variations is made very obvious in this work. With the aid of fellow-workers in Switzerland, Germany, Italy, and Greece Dr. Wolf determines, for every day in the year, the number measuring the frequency of the spots. From these numbers he can calculate the variations of declination of the needle at a given point on the earth's surface when two constants have once been determined for the place (as in calculation of tides). Thus, take Batavia, the constants are 2·130, and 0·0185; the number, R, of the spots is connected with the variation in declination by the simple formula, $v = 2'130 + 0'0185' R$. From a list of the variations as observed, and, as calculated from the spots, it appears that the average divergence (in 1868-9) is only about $\pm 3''$. Dr. Wolf's observations justify the expression "cosmic meteorology."

Explanation of Solar Spots Proposed by Professor Reye, of Strasburg.—M. Faye.—Dr. Reye considers that waterspouts and cyclones are exactly the same kind of phenomena as the small whirlwinds in our streets. They are due to the ascent of the lower layers of air when the vertical decrease of the temperature has become such as to render the equilibrium of the atmosphere unstable. Then the least accident will cause, here or there, the ascent of a puff; and once the movement has commenced the air of the lower layer flows towards this point. By the narrow orifice considerable masses then arise from all sides, widening more and more (upwards) the channel of ascent. The lower hot air, dilating in the upper regions, has part of its vapour condensed, and the heat due to this condensation, rendering it still lighter, adds to its ascensional force. Then, as to sun spots, Dr. Reye's view is that when a facula forms on the solar surface the extreme heat from it causes, in a limited region of the photosphere, the following phenomena:—The temperature of the atmospheric layer immediately resting on the facula rises, and renders the equilibrium unstable. The mass of gas and vapours composing this layer tends to rise into the upper layers. There may then be formed above the facula a sort of waterspout (*trombe*). The cooling which results causes condensation of vapours, and produces within the opacity necessary to mask the subjacent region of the atmosphere. This cloud may be 100 or 200 German miles in height. Below it, and laterally, gaseous masses will escape in conical sheets. Already partially deprived of this vapour, these will deposit much higher a number of small opaque clouds, which will form the penumbra. At length this gaseous mass, quite deprived of vapours by successive condensations, will play violently above the chromosphere and outside of the penumbra in flames of nearly pure hydrogen. Dr. Reye does not dispute Wilson's celebrated observation that the spots are cavities, but he urges that this observation is as well satisfied with funnels situated above the sun, as with funnels situated in its very mass. On this M. Faye remarks as follows:—Suppose a circular vessel in the middle of a table to be viewed obliquely by an observer too far off to have perception of relief. He is required to decide whether the vessel is simply placed on the table, or inserted in a circular hole such that the whole body of the vessel is under the surface. He will perceive two ellipses which are not concentric. Now he can, by measuring on the perspective tableau the distance from the bottom of the vessel to two opposite edges, decide the question. If these distances are equal the vessel is exterior to the table; if the distance from the bottom of the vessel to the table-edge next the observer is the smaller, the vessel is inserted in the table. This principle, applied in solar measurements by Mr. Carrington, has shown that the cavity of the spot is always in the body of the sun. A second method is that of considering the upper orifice of the penumbra; and P. Secchi has found that the centre of this orifice does not undergo displacement, whatever its distance from the centre of the sun. Hence, the upper orifice must be level with the photosphere, and not 900 or 1000 German miles above it. A third and still more simple method is that of a sectional view. The vertical ascending "waterspouts" when they reach the border should be visible and brilliant during total eclipses. But it is not so. Besides, at ordinary times, the spots are observed to disappear at the border like simple holes, without indication of relief. All tends to show that the spots are not without the sun in its atmosphere, but in the thickness of its brilliant mass.

Easy Method of Measuring the Capacity of Ships.—M. D'Avert.

Production of Galls on Vines Attacked by Phylloxera.—M. Max Cornu.

Reproduction of Phylloxera Quercus.—M. Balbiani.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, October 27, 1873.

Action of Formiate of Soda upon Sulpho-Benzoic and Benzoic Acids.—V. Meyer.—The author shows that

when formiate of soda acts upon sulpho-benzoate of potassa in the manner which he adopted no terephthalic is formed. Sulpho-benzoic acid is converted by formiate of soda into isophthalic acid, in circumstances in which no aromatic dicarbon acid arises from benzoic acid. Hence he concludes that the isophthalic acid formed on fusing sulpho-benzoate of potash with formiate of soda arises from the direct replacement of the sulpho group by carboxyl, and not from the benzoic acid re-formed in the reaction.

Constitution of the Benzoic Series.—Victor Meyer.—The author observes that no chemist will seriously maintain that the constitution of any chemical compound has been established with absolute certainty.

Decomposition Products of Bichlorpropionic Ether and Amide by means of Lime.—A. Klimenko.—The author declares that his results are as yet insufficient even for a preliminary notice.

Utilisation of Platinum Residues.—Th. Knösel.—The author communicates a process for preparing chloride of platinum from platinum residues, and from the alcoholic washings. The precipitates are placed in a porcelain capsule, and are mixed with caustic soda, heated upon the water-bath, and the alcoholic washings gradually added. The reduction is rapid, and the metallic platinum is deposited in a spongy state. The reduction is at an end when the supernatant liquid appears almost colourless. It never becomes quite colourless, on account of the formation of certain organic compounds which impart a faint yellow tinge. The metallic platinum is repeatedly washed by decantation with boiling water, and then washed upon the filter till the reaction of chlorine disappears. It is then dried, heated to redness, and is then ready for further treatment. It is boiled in hydrochloric acid to remove impurities, and then dissolved in aqua regia, preferably in the water-bath. The chloride of platinum is repeatedly evaporated to dryness, and re-dissolved in boiling water to remove nitrous acid. Finally, the solution is bleached in direct sunlight.

Certain Constituents of Poplar Buds.—J. Pickard.—The author corrects certain typographical errors in his communication in No. 13.

Revolution in the Soda Manufacture.—Rudolf Wagner.—The author gives the history of the gradual development of the "ammonia process," and a view of its advantages.

New Hydrate of Quinine.—A. C. Oudemans, jun.—The author found two samples of quinine containing 9 equivalents of water of hydration instead of 3, but was unable to explain their formation.

Molecular Deflecting Power of Tartaric Acid and its Salts.—A. C. Oudemans, jun.—A critique on Landolt's paper (*Berichte*, vi. p. 1072).

Nitro-Compounds of the Fatty Series.—Victor Meyer and C. Wurster.—The authors examine the action of sulphuric acid—both fuming and ordinary—upon nitro-ethan, and also that of alcoholic potassa.

Peroxides of Barium, Strontium, and Calcium.—Remarks upon Mr. Convoy's paper (read before the London Chemical Society, June 5), with whose results the author generally agrees.

Communications from the Odessa Laboratory.—W. Markownikoff.—The author describes the conversion of diæthoxalic acid into diæthyl-acetic acid, the formation of polymeric isobutyl-aldehyd, the properties of ceton, and some methods of forming the compound ethers.

On Cyanide of Thallium.—C. Fronmüller.—The author found that the cyanide of thallium is readily soluble in water; easily decomposed by the carbonic acid of the air; that its aqueous solution is completely decomposed even in the absence of air; and that the compound cannot exist in the dry state at low redness. He obtained the cyanide by mixing a saturated and boiling solution of sulphate of thallium with its equivalent of a boiling saturated solution of baryta, and filtering off the sulphate of baryta in a flask. When cold the solution of protoxide of thallium is mixed with an excess of concentrated prussic acid. After agitation alcohol is added in excess, and as much ether as will dissolve in the liquid. A heavy, amorphous, white precipitate falls down. It is freed from the mother-liquor by decantation, washed with a mixture of alcohol and ether, and dried under the air-pump. Its composition is—

Thallium	88·69
Carbon	5·21
Nitrogen	6·08
	99·98

The solution of cyanide of thallium dissolves the cyanides of silver and zinc, forming double salts much more stable than pure cyanide of thallium.

Alizarin as an Indicator in Titration.—Eugen Schaal.—The author finds that alizarin is far more sensitive than litmus, so that it shows distinctly $\frac{1}{3000}$ of alkali, whilst a neutral solution of alizarin, strongly diluted, is coloured yellow by 0·0007 of hydrochloric acid. The author prepares his solution of alizarin by dissolving this substance in boiling potassa lye with a drop of carbolic acid, and filtering in the cold. The neutralisation of acidity is marked by a change from yellow to rose colour.

Various Communications.—F. Beilstein and A. Kupfer.—The authors treat of the cymols of the oil of carraway, and of camphor; of cymol-sulphuric acid and its salts; of the oil of wormwood and its product, absinthol; on cuminic acid and its salts, and on the metallic derivatives of cyanamid.

Investigation of Cholic Acid.—F. Baumstark.—The author examines cholic-ethylic ether, cholamid, and cholic-benzoyl-ethylic ether. He finds that dilactylic acid corresponds to choloidinic acid, and lactid to the product of the dry distillation of cholic acid.

Diphenyl-Acetic Acid and Benzilic Acid.—R. Symons and Th. Zincke.—The authors examine the diphenyl-acetates of barium, calcium, zinc, and silver, and its ethylic ether. They consider it proved by their results that benzilic acid has the formula ascribed to it by Staedeler.

Synthesis of Tauro-Carbaminic Acid.—E. Salkowski.—On leaving in contact taurin and cyanate of potash in equivalent proportions the mixture deliquesced at first, and in two days was resolved into a crystalline mass—the tauro-carbaminate of potassa.

Reimann's Färber Zeitung, No. 42, 1873.

This number contains a receipt for a logwood-blue on wool, which bears soap and, to a slight extent, fulling. 50 lbs. of wool are boiled for an hour with 1 lb. of yellow chromate of potash, 5 ozs. of sulphate of copper, and 10 ozs. of sulphuric acid, and allowed to lie overnight in the decoction. The next morning it is dyed in a fresh bath with 5 lbs. of logwood, 3 lbs. of prepared tartar, and 4 to 4½ lbs. of the coarsest neutral extract of indigo.

There follow receipts for a dark green on fine wools; a dark green on inferior goods; a Russian green; a vat green on wool; a drab-grey on old silks; a reseda on old silks; a brown on mixed goods; a red and white (printing) on a black ground; a pansy and a maize on silk; an olive; a reddish Havanna and a yellowish Havanna on plush; a chamois; crimson II.; crimson I.; rose III., II., and I. on wool (printing); and a ponceau on shoddy.

Discovery of Artificial Alizarin.—The original idea is assigned to Strecker, and to Graebe and Liebermann the honour of its practical execution.

Royal Institution.—At the General Monthly Meeting, to be held at 2 o'clock on Monday, December 1, a President will be elected in the room of Sir Henry Holland, Bart., M.D., D.C.L., deceased.

THE CHEMICAL NEWS.

Vol. XXVIII. No. 732.

A DISCOURSE ON ATOMS.

I see that some chemists are giving themselves a good deal of trouble by discussing the atomic theory without distinguishing between that of Leucippus and that of Dalton.

The first is open to discussion, and will long be. We must learn much concerning matter before we can say with certainty that it consists *primarily* of indivisible particles or atoms.

The second—namely, the theory of Dalton—is not, in my opinion, open to discussion, simply because no one has yet opened a door sufficiently large for a doubt to enter by. Is this a mere matter of opinion? So far as I see, it is not, and all chemists confirm it in practice, willingly or unwillingly.

Now why should one theory be doubtful, and the other not doubtful? The reason is clear enough to the writer, but it remains to be seen whether it will be clear enough to all. It is this. The physical atoms of Leucippus and his school are the least possible divisions of matter, or, if you please, the smallest created or existing parts. The atoms of Dalton are not necessarily so. They are only the smallest of which we may be said by reasoning on our experiments to know anything, and they may be for all we know, and they probably are, compound molecules. The atoms of Leucippus are indivisible according to theory; the atoms of Dalton are indivisible by our chemistry. As such, and as such only, can we view the atoms of Dalton. Dalton's theory is an expression of the facts of the science of chemistry, but the atoms of Leucippus, and Epicurus, Lucretius, Newton, and even Dalton himself, considered as a physicist, are no help to us. The Greek atom is still undivisible; the Daltonian is undivided.

Let us take a drop of water, and divide it as far as Nature ever divides it, and it still contains oxygen and hydrogen. Let us divide it as much as you can imagine it divided, and still it contains oxygen and hydrogen; you cannot even conceive a piece so small that it shall not contain these two elements. Yet it is an atom of water—one indivisible quantity, let it be large or small. Nevertheless, after you have gone as far as you can conceive, even to the size of one atom of one of the two elements in the water, if such a paradoxical idea pleases you, the atom is divisible into oxygen and hydrogen. You may follow this idea as far as you please, you make only this, that infinite divisibility is beyond our understanding, and, when we speak and think of it, we have always something finite in our minds. You divide even water, which you know to be compound, to any extent you please, mechanically, and then you have a chemical division beyond it. The division of a sea of water and an ultimate particle is one in science, and Dalton says, Whatever amount of water you choose to imagine, I say it has a definite quantity of O and H. Why is it so? The simplest reason I can find is this, definite bulks unite to form the compound; if the bulks were not definite, then mixtures of elements would occur of various kinds, and we might have an infinite number of compounds of H and O. The fact of definite compounds being constantly formed is a presumption of a definite size existing for the ultimate particles. But do you mean to say that an atom of salt may be supposed to lie at the bottom of a sea of water, supposing only one atom to be there? I mean, at least, to say that, if an infinitely small quantity of salt were put into a sea of water, it could not be dispersed equally over the sea without bringing in new and still more incomprehensible relations between one part and another. When a small quantity of oxygen fills a large space, we are obliged to suppose motion in the particles, an attempt to be in several places at once, and without this theory we have more difficulty. It suits our understanding, and the nature of the things we see, to say at once that an atom of salt may be supposed to lie at the bottom or top of a large quantity of water.

But, says an opponent, I look on the elements themselves as mere centres of forces, and, if so, there can be no atom.

Dalton might say: "They may be centres of forces for all I know, but that does not take away from them materiality; it is merely another mode of expressing matter."

Opponent: "Not exactly, because if there is only force, then it may be infinitely divisible, or, at least, it can be conceived so more readily."

Dalton: "I do not see this. If a piece of iron is proved to be a force, it is not the less a piece of iron. If an ultimate particle of water be proved to be two forces or more, it is not the less a particle of water, and divisible into H and O, which you may call gases or forces as you please."

Opponent: "But, if they are forces, then it may be that, when we find O and H uniting, it is an act of many unseen powers very complicated, none of them being elements, but making elements by combining."

Dalton: "That is the same supposition virtually as before, but remember it is a supposition, and I came to deliver you from many such fancies. If it be true, then I may assure you that these forces come in very definite quantities, and act as much by quantity as my supposed atoms do, and if they become solids they must be treated as such. Indeed my idea of obtaining definite compounds by bulks or ultimate parts has expanded itself into the idea of equivalents, a very useful word invented by that most ingenious chemist Wollaston, and my pupil Joule has extended it to force—its rational development. To me it matters not whether force be the original of matter or not, or whether force and matter be the same or not; surely I am quite well acquainted with such variations. Although I call Wollaston ingenious, I do not admire his word equivalent. It arises from a suspicion and unfamiliarity with the idea, or, as I would say, from ignorance."

Opponent: "But, then, if there is force only, and not bulk, to begin with, how do you get the combination to be definite?

Dalton may say again: "I found it difficult, and therefore I kept to matter, which, however, may simply be the expression of force. I take it, however, in the shape given to me by nature. No one has ever shown me an oxygen-producing force in action. Still let us examine the proposition. If oxygen should occasionally split up into X and Y, forming two elements, it may be that all our other elements may do the same, or something similar; we might then have many more elements, or fewer, perhaps only one at last. That I think possible enough. We should then have a chemistry beneath our chemistry, a new era like that

brought in by Davy when he began the chemistry of the earthy and alkaline oxides. That newer chemistry may come, but it must apparently be caused by a new power, because we have tried to decompose our elements by the forces we have, and they will not yield. If one prefers to speculate on such a chemistry, let him do so; but do not suppose that any such result will alter the present theory as applied to present natural conditions."

It is clear that no one has yet explained how the smallest quantity of water, and the largest, should have a definite composition, except Dalton; and many men have tried it. If one O and two H's unite to form every conceivable portion of water, nature has given us no reason to suppose that these parts can be indefinite. The first conceivable portion of water being composed of two parts is not infinitely small. If you say that, both being infinitely small, two must be so also, I must demur; two nothings do not make a something, but two infinitely small bodies must, even to our imaginings, make something more definite. At the same time, however, I must remind you that we cannot understand the meaning of "infinitely small," and when we struggle we make in our minds a definite size. The same thing applies to "infinitely divisible." At the same time, this is not conclusive, only illustrative, and the best arguments lie in the fitness of the Daltonian atoms to make definite compounds. I object to have an intelligible theory put aside by an unintelligible, even on the supposition that perhaps it may some day be intelligible. Notwithstanding difficulties, men will rush at infinitely divisible matter, and form definite compounds out of it. By what means do they obtain the first idea of definite size? Dalton shows how he begins it. Let us learn another way of beginning it. How does volume come out of no volume? How does equivalent come out of shapelessness? It is as easy to throw clay into the fire unshapen, and to bring out bricks; it is as easy to decide how something came from nothing. We are compelled to seek a beginning for ourselves to rest on, uncertain whether a real beginning, to which we cannot attain, preceded that which we seem to comprehend. If you will go farther, and break up our chemical and intelligible atom into a theoretical one, you begin a new science; but you must feel uncertain whether you will ever be able to experiment with these new elements of the sub-Daltonian atoms, or Daltonian substratum of matter without atoms; or whether we have passed out of the region of that more occult chemistry in cooling down, or whether we are moving towards it, and, in the condition of mercury, shall attain it.

At any rate, I trust that in discussion chemists will remember to distinguish between the Daltonian atom of our chemistry and that of the mind bewildered with the incomprehensible idea of infinity. I do not enter on other proofs of atoms from the laws of gases, &c., &c.; I wish only to attempt to make an arrangement in discussing the Daltonian chemistry, and advise chemists to be careful in throwing aside opinions until they have better reasons than any given. The President of the British Association did good service by bringing forward the subject as I think.

Such ideas I have often spoken of, and you will not require me, I hope, to sign my name, as I have no time for discussion at present, and I can escape it better by writing simply as an ATOM.

November 20, 1873.

DIDYMIUM IN SCHEELITE.

By CHARLES HORNER.

Scheelite from some localities, I find, contains didymium, notably the specimens from Traverella, Piedmont,—plates of 2 m.m. thickness showing the characteristic group of lines at D to great advantage. Although the lines are very distinct, yet the amount of this element must be exceedingly small, since a borax bead saturated with the finely-powdered mineral failed, in a vitreous condition, to show even a trace when examined by the spectroscope. However, after allowing the bead to cool, and then gently re-heating it according to the plan adopted by Mr. Sorby, the didymium crystallised out, showing the spectrum to perfection.

I have observed didymium in Cumberland scheelite, but it appears to be absent from some American specimens.

Fern Villa, Mortlake,
Nov. 18, 1873.

ESTIMATION OF CARBON IN PIG-IRON.

By GEORGE S. PACKER.

The following method for the estimation of carbon in pig-iron, and having reference to a paper by Mr. C. H. Piesse (Chemical News, vol. xxviii., p. 198) on the same subject, may be of interest to some of your numerous readers:—

2·5 grms. of pig are treated with 50 to 60 c.c. of $CuSO_4$ (1 : 5), and, after standing 7 to 8 minutes in the cold, the solution is gently warmed, until the pig is completely decomposed; there is then added 20 to 25 c.c. of $CuCl_2$ (1 : 2) and 50 c.c. of (pure) strong HCl, and the solution is gradually brought to boiling; by this time the precipitated copper should be re-dissolved (time, 45 to 50 minutes); it is then filtered through an asbestos filter, made as follows:—

The usual asbestos funnel—a tube about 8″ long and 1″ diameter, drawn out at one end to a neck about ⅝″ diameter—has some pieces of very thin glass rod, about ½″ long, placed side by side firmly in the narrow end, and above these some previously ignited asbestos, loosely plugged, about ½″ thick layer; some hot water is then run down the funnel to consolidate the asbestos, and the solution is then filtered and washed in the usual way.

This filtration and washing can be done in 5 to 7 minutes, unless the pig be very siliceous, when it sometimes takes 20 to 30 minutes; if the solution be allowed to boil for some time, or even stand (over-night, for instance), the Si forms gelatinous SiO_2, which greatly hinders filtration. The asbestos and carbon are now placed in a 200-c.c. flask with 3 grms. C_2O_3, using as little water as possible for rinsing in; the flask is fitted with a 2-oz. stopcock funnel and delivery-tube to conduct the gas first through a U-tube containing some H_2SO_4 only (I find a wash-bottle and H_2SO_4 allows the acid to run back if a draught should blow the light under the flask a little on one side for an instant), and then through one containing broken glass and H_2SO_4, and then into potash-bulbs. The funnel is filled with strong H_2SO_4 (40 c.c.), and, when the connections are all made, the acid is allowed to flow slowly in; the solution is gradually brought to boiling, and kept so a minute or two, till all evolution of gas ceases; air is then drawn through the apparatus, allowing it first to pass through potash solution to absorb atmospheric CO_2, and the bulbs weighed. Time, 1¼ to 1½ hours.

This method is a modification of that of A. H. Elliott, given in the last edition of "Fresenius" (by A. Vacher). I have described it rather fully for the sake of any who may not have easy access to the above-named edition.

My intention in writing this has been to call attention to the method, which gives very con ordant results, and can be executed with great rapidity. I have repeatedly done a determination, including all the necessary weighings, in 2¼ to 2½ hours. In the case of steels, or in pigs where the drillings cannot be obtained so fine, of course the

solution in $CuSO_4$ takes longer; and in steels, where a larger quantity must be taken for analysis, the reagents must, of course, be proportionately increased,

Hallside Steel Works, Glasgow,
Nov. 21, 1873.

COMMUNICATION FROM THE LABORATORY OF CHARING CROSS HOSPITAL.

By T. BOLAS.

On the Estimation of Oxidised Nitrogen in Potable Waters by means of the Ferrous Sulphate Test.

IN testing for nitric acid as already described (CHEMICAL NEWS, vol. xxviii., p. 249) it is quite possible to float the aqueous liquor on the vitriolic fluid with such steadiness as to cause the surface of the latter to assume the form of a sharply-defined meniscus. In this case it is necessary to give a slight rotatory motion to the vessel containing the test in order to produce the small amount of heat which is required for the production of the dark compound. The formation of a meniscus should always be aimed at, as a much greater intensity of colour is attained when the meniscus is produced, and subsequently destroyed by careful rotation, than when the aqueous liquid is added in such a way as to cause a sensible amount of agitation. When the "nitric acid test" is employed, the dark tint appears in the vitriolic stratum, and not, as when the ordinary method is used, in the aqueous stratum; and, moreover, if the rotation be continued, the upper portion of the vitriolic stratum remains coloured to the last, even if the aqueous liquid has become hot enough to instantly decompose the dark compound.

Under any circumstances, the quantitative indications obtained in this way are, as previously pointed out, somewhat vague. This arises, to some extent, from the difficulty of producing equal temperatures in both tubes. The delicacy of the test, when performed as now recommended, is fully equal to that attained in the usual way, 1 part of oxidised nitrogen in 25,000 being recognisable in either case. When, however, the operation of testing is conducted in such a manner as to produce the dark tint throughout the whole mass of the liquid, the delicacy of the reaction is increased four-hundred-fold, and 1 part of oxidised nitrogen in 10,000,000 parts of water becomes capable of recognition; and, moreover, the tints thus produced are well adapted for the colorimetric determination of small quantities of oxidised nitrogen.

The colorimetric comparison is best made by mixing the water to be examined with its own volume of pure sulphuric acid; and, after cooling, 80 to 85 c.c. of the mixture are placed in a tall jar, 15 to 20 c.c. of the nitric acid test being then added, and under these circumstances the heat produced is sufficient for the formation of the compound $2(FeSO_4).N_2O_2$, but it is not sufficient to destroy this compound. These proportions are suitable when the temperature of the materials is 14° to 17° C., and a rise of about 10° takes place on mixing. Having thus produced the brown tint in the test, a mixture of vitriol with an equal volume of a standard solution of nitre is similarly treated, and the tints of test and standard are compared. If the standard is rather darker than the test, a portion of the former may be removed in order to make the intensity of colour equal in both jars, and, of course, the portion removed must be considered in calculating the results. Similarly, a portion of the test may be removed if its tint is slightly darker than that of the standard.

When waters containing a large proportion of nitrates are being examined, it is advisable to use smaller jars than those required for 100 c.c. of liquid, and it is scarcely necessary to remark that evaporation must be resorted to when the proportion of nitro en is smaller than 1 in 10,000,000. If the water contain organic matter which blackens under the influence of vitriol, or if it is naturally dark in colour, it must be distilled, with the addition of about one-fourth of its volume of sulphuric acid, and the distillate, which should be equal in amount to the water taken, must be treated as described above.

In preparing the nitric acid test, it is better to use pure oil of vitriol than the commercial article, as in this case the application of heat is not required. Although a solution of ferrous sulphate containing far less of the salt than the amount required for saturation may be used in the preparation of the nitric acid test, it is advantageous to prepare it according to the directions already given, and to allow the deposited crystalline salt to remain at the bottom of the stock-bottle, the separating salt acting to some extent as a decolorant.

In order to avoid an undue consumption of vitriol in making comparisons, I intend to try how far discs of glass, either coloured, or covered with a coloured varnish, may be substituted for the standard solutions.

Charing Cross Hospital,
Nov. 18, 1873.

ON HEAT.*

By FREDERICK GUTHRIE, B.A., F.R.S., &c.

THE "Sources of Heat" and "Expansion" were treated of as follows:—

In considering what we may call the laws of any physical force, we are necessarily led some time or other to study the way in which the force affects ourselves. In fact, the only inlet is through our various organs; but in all, or most cases, it is necessary, before studying this, to get some notion of the objective relations of the phenomena themselves. The eye is generally the organ which is selected for final accurate measurements. Although we may appreciate sound through the ear, yet we may feel the body throb with our hands even. We may distinguish between pitch by the ear, but for accurate measurements we refer to the eye. Measuring wavelength is a thing chiefly of vision, partly of touch, but not of hearing, taste, or smell. So, in considering heat, we shall soon find ourselves compelled to come to the eye. With regard to the sensation of heat, of course you usually understand that it can never furnish an accurate measure of temperature. The sensation of heat appeals to the same nerves as the sensation of touch, but the body itself has a certain temperature, and what you really feel as the sensation of temperature derived from touch is not a direct appreciation of temperature at all. But it is an appreciation of loss or gain of heat in those liquids surrounding the nerves of touch, and whereas for the other forces, such as sight and sound, taste and smell, bundles of nerves are employed, almost all parts of the body are sensitive to heat. The different nerves are differently sensitive to heat as to touch; but the same nerves which take up the sensation of touch take up the sensation of change of temperature—the loss and gain of heat being what we appreciate by plunging our hands into hot or cold water. This gives rise to the terms hot and cold. My hand loses heat in cold water, and I have the sensation of cold, whereas another person, whose hand is warmer, may feel hot.

So, at starting, we are obliged to abandon the cutaneous sensation of hot or cold as a measure of temperature. It is simply a measurement of our own sensitiveness and the temperature of the blood at the time. We must therefore return to certain physical effects which will be referred to the eye as the measuring organ. Perhaps the most conspicuous physical effect is that of expansion, or the property which heat has of increasing the lengths of bodies.

Roughly speaking, we may lay down the rule that all bodies expand by heat; that is, if we take a cubic inch of matter, on heating it becomes a cubic inch and

* Abstract of the first of a course of Lectures to Working Men, delivered in the South Kensington Museum on Monday, the 17th ult.

something more, expanding in all directions. If we take a linear yard of matter, that yard expands the same fraction of its thickness in all directions as it does of its length. In this way, by taking a thin and long rod or wire of matter, I may exaggerate expansion and render it palpable.

A platinum wire is made red-hot by passing a current of electricity through it. One end of the wire is rigidly fixed to an upright rod, while it is kept stretched by a weight at the other end. This weight is in communication with an index, which shows the lengthening of the wire on heating and its construction on cooling. The same effect may be shown by a copper sphere which passes through a cold ring of brass; but the ball, heated for a few seconds, expands, and refuse to pass through until it cools to the temperature it was before, or rather till the ring and the sphere reassume the same temperature, both higher than to begin with.

One may also appeal to the sense of hearing, in order to prove the expansion of solids by heat. A rocker of copper is placed upon a bar of lead and heated, but no action ensues. If the rocker be tipped on one side, however, it causes a little mountain of lead to be formed, which tilts over the copper just as in shrugging the shoulders. This takes place so rapidly—more than sixteen times in a second—that one hears the successive blows of the copper on the lead. They produce a musical note, just as all rapidly succeeding sounds do.

All these experiments have been to show the expansion of solids, sometimes appealing to the eye, sometimes to the sense of hearing. Now let us see that liquids expand when they get hot; after that we will take the third form of matter—gaseous, and show that gases expand also.

Let us take, as three typical liquids, water, alcohol, and mercury. Surround these with hot water; and, as solids expand by heat, the first effect of this hot water will be to heat the glass and increase its capacity, just as the hole of the ring increased. The level of the water sinks because the same quantity has to fill a greater capacity; but the glass does not expand so much as the water, hence the expansion of the water prevails over the expansion of the glass, and the level of the water rises. Alcohol and mercury behave in a similar manner.

In the same way, let us take an example of the most familiar gas of all, or a mixture of gases—atmospheric air. That air expands when heated is illustrated by many toys, the balloon depending on the fact that heated air is lighter than cold. We have, say, a cubic yard of air; expand that, and it still has the same weight when expanded as it had when cold; but take a cubic yard of that expanded air, and the weight is evidently less.

Coming from toys to scientific instruments, we have here a means by which atmospheric temperature can be measured. The differential thermometer, so-called because it shows when the one bulb is heated more than the other, and not that one place is warmer than another, is composed of two bulbs connected by a glass tube twice bent at right angles. The air expanded by heat forces a liquid or an index towards the other bulb, and thus variation in temperature is communicated.

Having seen that solids, liquids, and gases expand by heat, let us pursue the subject further, and see the expansion which *different* solids undergo by heat.

If I surround a brass rod with ice-cold water, then with boiling water, marking the expansion, afterwards expose a similar rod of iron to the same conditions, there would be a difference of expansion between the two metals. The expansion of different metals are measured roughly in this way.

That solids expand differently for the same temperature may be shown by a bar of iron rivetted to a bar of brass. The bar of iron below receives the heat first, and expands, and the bar bulges out towards the iron; but iron does not expand so much as brass for the same increase of temperature; hence, when the heat has penetrated through the iron to the brass, the brass assumes the form of the arch to gratify the relative expansion of the two metals. Another means of showing the same effect is by a compound ribbon of platinum and silver in a spiral form. On the application of heat the spiral unwinds, because of the expansion of the inner coil of silver, and on cooling it is reversed. Attached to an index on a dial, this is used as an atmospheric thermometer. We have established the point that solids expand unequally for the same increase of temperature, and this inequality also prevails with liquids.

We will experiment with three equally filled flasks of water, alcohol, and mercury, all heated to the same temperature. The difference in expansion is seen in the different level of the various liquids.

In the case of gases, no such inequality of expansion exists, as different gases expand to the same fraction of their volume when heated through the same range of temperature.

ON THE ENERGIES OF THE IMPONDERABLES,
WITH ESPECIAL REFERENCE TO THE
MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 275).

Lecture VI.

The Energy of Light, especially with reference to the Measurement and Utilisation of it.

The energy of light is all-pervading. Wherever life is, there this energy is. Darkness, or absence of light, is another name for death. That our knowledge of the mode in which this energy acts is "cabined, cribbed, confined," there can be no doubt. It has, however, an extended influence; indeed, there is reason to infer that it has an actual active kinetic power which may be described as enormous, even when separated from its usual allies, heat and actinism. The very small area of explored light-land only serves to assure us by its embarrassment of rich energies that in respect to light there are not only as great, but even greater developments to be made, than have yet taken place in any of the "imponderables."

The animal, vegetable, and mineral kingdoms; solid, liquid, and gaseous matter, each, in some form or other, admits of the energetic action of what passes under the general name of light. Such universal consent to the power of light, which recent science investigations seem now, for the first time in the history of the human race, to be making known, is rendering a spontaneous but somewhat unconscious and undesigned testimony to the truths of Scripture. In the first chapter of the book of Genesis, and at the third verse, we read that the very first act of creation is light—"Let there be light." It must be admitted as singular, very singular indeed, that that old book—the Bible—about which some men cavil, should have had written in it of events occurring, say, 6000 years ago (six million years ago, if you please), that which science-investigation of the last 50 or 100 years has only made clear to all who read. Strange that this, "offspring of Heaven first born," without which no life can even now be sustained in healthy vigour, should have been formed in the fulness of energy before revelation asserts that life was. The strangeness ceases when the religious faith in inspiration enters.

Before this lecture is closed the conclusions and illustrations, if successful, will prove that, whilst this energy is less comprehended, and, if possible, more perplexingly mysterious than even the energy of affinity, it is nevertheless one whose presence is for vigorous action. Even the conducting power of bodies for electricity have within the last few months been shown to be so connected as to be influenced by light.

It is not in my power to produce the experiment, but it may be stated that if a small bar of selenium—say two inches long, and one-eighth of an inch diameter—have

* The Cantor Lectures, delivered before the Society of Arts.

its ends electrically connected with such a galvanometer as you saw last week, then the speck moves as light shines upon or is excluded from the bar.

The sources of this energy are the sun, the stars, and meteors which, in some way unknown to us, setting aside the theory of luminous heat consequent upon atmospheric friction, are self-luminous.

There is no similar self-luminosity on earth. If it be wished to obtain light from other and accessible sources it is done by extraneous agencies. Heat caused either by affinity, electricity, or mechanical means, or by a concentration of the energies of some self-luminous source, is the way by which we usually produce light.

This process of production by concentration from self-luminous sources, although generally adopted, is very unpromising as a means for ascertaining the energies of such source-produced light. For this reason—as the light passes through or is reflected from the bodies employed in the concentrating operation, the extent or degree in which this energy may have been expended in chemical or physical work within or upon the concentrating body cannot be ascertained. Hence the remaining work—be it represented chemically or mechanically—is all that is left for investigation. It represents but the balance of the account. Now, as a coin so small as one shilling may represent the balance of two accounts, neither of which reaches one pound, so the same coin may represent a balance of accounts reaching many thousand pounds. Clearly, then, from this remaining work no inference can be drawn respecting the total of the energies involved in the production of such a balance.

The energy of light varies with the source from which it originates. In some respects, viz., as regards heat and light, properly so called, the energetic elements in what we call the electric light are more similar to those in the sun than any from other lights within our means of artificial production; in another respect, viz., chemism, or actinism, the energy of that from the combustion of magnesium is nearer to solar light than is the electric.

There are two lights which seem to have in themselves no traces of an energy producing effects on any of our appliances. They are the result of some unknown and as yet unappreciated energy. These are lights due to phosphorescence and fluorescence.

The decay of what was once possessed of the energy of vitality is a condition manifesting phosphorescence, a state in which light is without much (if any) heat. Whether the light on being given out is the result of some new operation of what was once called the vital principle, or whether it is a consequence of some elements of affinity approximating in character to those we call combustion, is an unsolved problem. Friction, also the passage from a formless state to the state of crystal, frequently causes a phosphorescent light to be emitted.

Phosphorescence is a name also given to a mode of obtaining light which seems to depend upon the property that certain bodies possess of rapidly concentrating within themselves the light they may receive from being exposed in the neighbourhood of a luminous body, and then emitting this absorbed light gradually. Probably the light stored up in a few seconds is not emitted in less than minutes.

Diamonds and other substance shine in the dark for a short time, after exposure to intense light. This shining of certain crystals, in the absence of light, probably led to the opinion that such crystals were living beings, petrified by light in the hands of men. Certain flowers, especially those with bright *yellow* petals, sometimes emit a sudden flashing light a little after sunset; also, some plants growing in mines emit light from their whole surface. Certain preparations continue to emit this light so intensely and continuously as to be used as night-lights—not for illuminating rooms, but for such purposes as reading the hands of a watch.

There are in this box a series of tubes which, doubtless, appear to all of you, at the present time, perfectly white. If, however, we allow an intense light to shine upon them, they are seen to possess a phosphorescence that will last some time—from ten minutes to half-an-hour, as the case may be. This magnesium lamp shall be lighted, and the tubes exposed to its rays for a short time, and you will see, not only the simple phosphorescence, but different colours which the contents of each tube assume.

Fluorescence is a peculiar appearance consequent upon placing some substances in certain position with respect to light. This may be illustrated by the action of light upon sulphate of quinine. In this bottle is what appears as pure colourless water; it is a very weak solution of sulphate of quinine. If looked at in the presence of light rich in actinic rays, a change in the appearance is observed. A piece of magnesium ribbon is now lighted. In certain angular positions a beautiful azure blue may be noticed; this blue is a consequence of those phenomena called fluorescent. These, phosphorescence and fluorescence, are two characteristics of the energy of light, of which all we know is that we can render no account of the causes of them, unless the theoretical explanation be accepted that the two may be classed as one—by regarding them as consequences of an alteration in certain wave lengths in portions of the entire beam of light. From the previous statements it may be inferred that the measurements of the energies of light are not yet accomplished; also, that two lights, which to the eyes do not differ much in intensity, or in what some might call power, yet may show very different energies. It must be borne in mind that here, as in electricity, intensity is not energy; there may be great intensity and little energy.

The great source of light is the sun, and whatever may be the speculations of science, either as to the cause of that light, or as to the mode in which it is propagated from the sun and received at the earth, they do not concern us at present. What we are concerned with is, how are the energies of the light thus received, and of such artificial lights as are utilised, to be measured?

A reference to the diagram of the spectrum may explain what is manifested by an analysis of solar light. Observe, there is shown in this spectrum heat, light, and actinism, or chemism, as it is sometimes called. The spectrum visible to us is the part thereon coloured, containing the usual prismatic colours, red, orange, yellow, green, blue, indigo, and violet; therefore the light, properly so called, and which is utilised by human eyes for vision, extends from the letter A to the letter H, and no further, and any energy consequent upon the state which occurs before the letter A, and any energy consequent upon the state beyond the letter H, is not the energy of light properly so called. Now, to our left of the letter A, extending over a space which bears a proportion to light, about half as long again as light, is a space containing the energy due to heat. To our right, beyond the letter H, extending to a distance longer than that of light, we have a space in which photographers and chemists delight. Chemists can get nothing out of this dark end to our left except heat, and chemists and photographers get nothing out of that dark end to our right except chemical action. The intensity of heat lies here, just before we reach light at all; and the intensity of chemical action lies there, just after we get beyond the light. No scientific investigation has yet detached the energy of light and its intensity from these two energies with which it is associated. At this line, marked D on the diagram, it will be noticed that those curves, indicating heat and actinism, die out. The one seems to be passing into the other. At D is what mathematicians might name a "cusp"—a zero on the scale similar to that zero in the arithmetical tables which may be said to mark the turn between counting by integers to the left, and by decimals to the right. At D is this dead blank for heat and actinism, and yet it is there the energy of light really lies. Before the end of the lecture something more

should be said about the energy of light at this particular point. Amongst these three constituents of a solar beam —heat, light, and actinism—there are several marked and extraordinary differences, yet we call them all "light." For instance, heat causes bodies to expand, but heat fails to make an impression upon the retina. Professor Tyndall, some years ago, put his eye into the focus of a heat beam where platinum was melted, and it produced no impression upon the eye. In his account of the experiment he says he did it, but he does not advise anybody else to do it—a piece of advice likely to be more generally accepted than advice usually is. This shows that heat fails to make an impression upon the retina. Heat also fails to produce any photographic result; heat can be conducted along metals, and heat can cause organic and inorganic bodies to expand.

Light, properly so called, possesses these qualities. It makes an impression upon the retina, it effects changes in organic bodies, and probably (in some way mysterious to us) in inorganic bodies also. Light does not possess these qualities—it cannot be conducted by metals, it cannot cause bodies to expand. Now, as to actinism, or chemism, it possesses these qualities—it produces photographic results and chemical changes in organic as well as in inorganic bodies. It does not possess these qualities—it fails in making an impression on the retina, it cannot be conducted by metals, and it cannot cause bodies to expand. Hence there seem to be properties in each portion of the spectrum which do not exist in the other; therefore in the comprehensive term—light—there are three distinct elements, and it is really an error to write them under the one name light. Great would be the social misunderstandings if, because wheat, barley, and oats are all called corn, or grasses, these general terms were as constantly applied to them as the term light is to phenomena with which it is associated, but not connected.

There is also another form in which the energy of light is presented, *i.e.*, in its penetrative power.

For lamps and lighthouses this penetrative power is all important. Certain substances in combustion are possessed of this power in a much higher degree than other substances. It is not, however, only in the material burnt, but further in the mode of burning, that this penetrative power is manifested. The same substances under different conditions manifest very different energies in the emission of light to a distance.

Even the ordinary paraffin lamps—how very inferior in illuminating power some are to others. The utilisation of the energy in the one and only way in which it can be utilised without waste is well illustrated in the various constructions for the burning of different hydrocarbons, to which time forbids further reference. Many present are aware of the different schemes now before the public for obtaining both light and heat from the combustion of the hydrocarbons.

But it is not in liquids only that this difference exists. Even the same quantities of gas—*i.e.*, of a suitable gas—one containing such an element as carbon under different circumstances, yields lights of marvellously different penetrative power.

Here is a common gas-burner; if a short tube having a few holes at the bottom be placed over it and the gas lighted at the top of the tube, you have a light which has a certain non-penetrating power. It cannot penetrate far; it has a pale blue lambent flame. Now if the tube be taken off, and the gas lighted at the burner, you have the same quantity of material burning, but with a very different penetrating power. In this case it is evident that the penetrating power depends entirely on the mode in which the apparatus is arranged for combustion of the gas.

From the remarks made it may be inferred that science is yet incompetent to pronounce decidedly, 1st, what or which element or elements in the solar beam constitute light properly so called; 2nd, even if this be determined positively, yet science is still undecided by what rule, or weight, or measure, the energy of light is to be gauged.

Indeed this remark may not be an exaggeration—in all probability no two persons see the same degree of light. It may be surmised that no two persons see any portion of this spectrum of the same colour, and, further, it is highly probable that there is no such thing as colour in nature at all. It is likely that colour is a pure impression produced upon the retina of each person's eye by the vibrations of the medium which strike upon it. Hence what we call red, orange, yellow, green, blue, indigo, and violet do not exist actually on the spectrum, but in the eye of the observer, and probably one person will see the red beginning here, and extending thus far, whilst others will see it beginning a little more to the left, and ending a little more to the right, or *vice versa*. Upon that point there is nothing really settled.

As to the first of the foregoing inferences the energy of light is said to be concentrated in the yellow portion of the visible spectrum. If the views of those whose pursuits are photographic are to be received, the perplexities of science are increased. The very name of their art—photography—indicates the writing of or by light alone.

The fact is that photography is not a process dependent upon light as light, but upon that portion of light which is possessed of certain peculiar and hitherto unexplainable influences of a chemical character. Photographic chemistry is as yet very partially understood—were it not that those who think they understand it might be offended, the truth would not be outraged by saying that photographic chemistry is not at all understood. And yet no process for estimating the energy of light, as light, has been suggested more hopeful for success than that dependent upon chemical changes; but these are not those chemical ones to which the photographer appeals. The fact is, that those changes appreciated by the photographer can be produced in inorganic compounds; what they are can be partially noted, they can be recorded, and that in terms which are but relative (not absolute), and which chemistry alone can measure. The day may not be distant when the energy of light, as light, will be duly and absolutely measured.

Judging from its place in the order of creation—previously named—judging from its influence over the whole world of animal and vegetable existences—judging from such facts as that when light is absent all animal and vegetable life lapses into a species of torpor, or sleep, and on the return of light nature awakes, and resumes its activity and strength, the conclusion is a very legitimate one, that in light—as light—there is great energy. Light opens the eyes, not of animals only, but even of flowers; hence one of our little English flowers is called "The day's eye." Those who can sleep through noise, and even through heat, are not insensible to the energy of even artificial sources of light playing, however gently, upon the closed eyelid. Medical men and nurses are well aware how essential light is for the regaining of health and strength by the sick or the infirm. Egypt and Madeira, as sanitaria or convalescent homes for our ailing brothers and sisters, may owe more of their influence to qualities or energies of light very different from those the photographer esteems than are usually allotted to them. And it may be permitted to add that marvellous testimony to some unknown element (be it figurative or be it real) which, whilst pervading all Scripture from Genesis to Revelations, assumes a most marked peculiarity in that expression of St. Paul (Eph. v., 14), "Awake thou that sleepest, and arise from the dead, and Christ shall give thee [marvellous gift] light" not life, observe, but "light."*

(To be continued.)

* This subject has been examined more in detail in "The Harmony of the Bible with Experimental Physical Science," published by Bell and Daldy, price 2s. 6d.

CORRESPONDENCE.

ALUM IN BREAD.

To the Editor of the Chemical News.

Sir,—"O_8" in his letter (Chemical News, vol. xxviii., p. 262) asks for an explanation of the "Shoreditch case." The commentators have so unceremoniously adopted the misleading statements made at the Shoreditch meeting of master bakers, excepting in the case of the *Times*, that one can only deplore their readiness to arrive at anything sensational by any means, and learn that truth is not always sought after. You intimate your intention of publishing an article on the subject; prior to your so doing, allow me to request you will read the enclosed copy of a letter sent to my Directors, who asked me for the full particulars of the case. It is curious to observe how, in hurried exercise of judgment, even technical journalists are capable of publishing most gross mistakes. One of these (*Iron*), in commenting on adulterations, observes that a chemist in seeking for sulphuric acid pursued a course that would effectually destroy it, alluding, I have no doubt, to a published statement of mine that "the bread was burnt in a platinum vessel, and the ash carefully examined for alumina, &c." This reporter or editor, in his wisdom, conceived, I suppose, that the sulphuric acid must be decomposed and lost, whereas the ash when oxidised should have yielded satisfactory evidence both of the presence of alumina and sulphuric acid, unless ammonia-alum had been employed; even then the water-solution or extract should have given evidence of H_2SO_4. In the Shoreditch case, the test failed to detect the constituents of alum (in any appreciable quantity) said to be introduced as an adulterant, and the question put to me was to determine whether it was "bad bread adulterated with alum," which charge it was certainly free from.

There has been so much misrepresentation that I gladly take this opportunity of placing the facts before you, that you may know what actually occurred and what course was pursued.—I am, &c.,

E. V. Gardner, F.A.S., M.S.A.,
Professor of Chemistry.

Royal Polytechnic Institution,
Nov. 25, 1873.

IRON FILINGS IN TEA.

To the Editor of the Chemical News.

Sir,—Mr. Alfred H. Allen (Chemical News, vol. xxviii., p. 275) says that he has found "genuine iron filings" and "real *lumps* of iron in tea." As the subject is of considerable practical interest, and Mr. Allen's testimony is of unquestionable value, I venture to ask him two questions—(1) Were these found in the ash or in the unburnt tea? and (2) How did he determine that the particles of iron were genuine filings, and what was the quantity of these and the lumps?

As regards the supply of iron filings, Mr. Allen says that he has no doubt that he could beg a hundredweight of finely divided iron to-morrow. My Sheffield experience, to which Mr. Allen refers, satisfies me that he is quite right, but would it be so easy to "beg" such refuse if it were systematically used for the adulteration of tea,—if there existed a market for anything like the quantity that I have shown would be required? It is just because they are not used for any such purpose that the various kinds of iron dust produced in Sheffield are so worthless. If there were a demand for the large quantity (5,000,000 lbs. per annum) that would be required for the alleged adulteration, all the iron-works of the world would, as I have already stated, be attacked by collectors of the material, and Sheffield—being capable of producing more than any other place in the world, probably more than could be produced throughout the whole of the Chinese Empire—would be thus attacked the most vigorously, and Sheffield iron dust would be worth as much as Sheffield armour-plates, and quite as difficult to "beg." If this adulteration were carried on at home, as Mr. Allen supposes, both he and I would have seen or heard of truck-loads of iron dust being loaded up on the sidings of the Sheffield railways and forwarded to London, which is the wholesale tea-mart of Britain.

While differing with Mr. Allen on this subject of iron filings, I take this opportunity of expressing my admiration of the manner in which he, Mr. Wanklyn, and Mr. Bird have studied the subject. The working of the Adulteration Act has strikingly displayed one of the most important influences of scientific education. The exceptional few of competent chemists who have had the courage to accept the post of public analyst have distinguished themselves by the modesty of their certificates; they have fairly measured the difficulties to which Mr. Allen has referred; and we might almost affirm that the amount of adulteration detected by the different public analysts has varied inversely with the amount of their chemical knowledge and analytical skill. The best chemists have, doubtless, best understood that their office demands a special technical skill, for which the education and experience obtainable in our ordinary chemical laboratories only affords the preliminary, though necessary, scientific basis, and that further and special preparation is necessary in order to qualify even the ablest of our chemists to fulfil satisfactorily the duties demanded by the Adulteration Act.

This is well illustrated by your article in last week's number of the Chemical News, on "Alum in Bread." Such difficulties as are there explained, and the conflicting evidence obtained in every prosecution where the shopkeeper has been able to afford the cost of obtaining further analyses than those of the public analyst, have proved the cruelty and injustice of the hasty and ruinous convictions that were based upon the half-crown analyses and superficial certificates in the early prosecutions under the new Act of Parliament, and enforce the necessity of the utmost caution in the meantime, until practical and special experience has enabled the public analyst to master the difficulties of his newly-created business.—I am, &c.,

W. Mattieu Williams.

PS.—Since the above was written, I have read the able summary of the Birmingham tea cases by Mr. Kinnersley, the Stipendiary Magistrate of Birmingham. It is fully reported in the *Grocer* of Nov. 29, and I recommend it to the perusal of your readers interested in this subject. It appears from this that further experiments have induced Dr. Hassall to reconsider his former conclusions; he has just written to state that he now concludes "that the iron detected in the tea *was not really iron filings, but magnetic oxide and crushed ore.*" This is a strong confirmation of my theory of the origin of the iron that has been detected in tea.

PUBLIC ANALYSTS.

To the Editor of the Chemical News.

Sir,—Will you kindly allow me space for a few remarks on the subject which called for your leader in the Chemical News of last week? I thoroughly agree with the remarks you then made, and I only think that they did not go far enough. The subject of the competence of the public analysts appointed under the Adulteration Act is a very important one, both from a social and from a scientific point of view; and I think I may safely say that the growing distrust of the public as to the value of the act itself, and particularly as to iits administration, is more than proportionally shared by members of the chemical profession generally, and who are not personally interested in carrying out the Act, but who look on from outside as impartial critics.

The adulteration question seems to oscillate, in the public regard, between two "poles," if I may use the

simile—the "positive" one of panic, and the "negative" one of indifference—both extremes being mischievous, but that one of panic being by far the most hurtful. Adulteration panics are often aided greatly in their development and progress by persons who, being ignorant of the subject on which they write, are therefore the more enthusiastic, or else by others who have some interest to serve by raising an agitation on the subject.

Much of the mischief arises from two very common abuses—viz., the appointment of incompetent men to the office of analyst, and to the plurality of appointments held by the same analyst. This latter often necessitates the employment of assistants, sometimes engaged at a low rate of remuneration, the only part of the duties performed by the public analyst himself (besides drawing his salary regularly) being the signing the certificates, and the assuming the responsibility of defending them if called in question in a court of law.

I, as a chemist, am glad to observe that most of the *fiascos* hitherto made public have been the work of medical officers of health, and not of regular professional chemists. When will people be disabused of the idea that, because a man may make a successful diagnosis of a medical case, he is, *ipso facto*, equally competent to perform a complex chemical analysis? These frequently occurring "mistakes" are calculated to lower the prestige of the analyststhip, not only in the estimation of the public, but, what is of much greater consequence, in that of the better part of the chemical profession. It is to be feared that all this will end in deterring competent chemists from accepting the office of public analyst, and will leave the vacancies to be filled by young and incompetent members of the profession, or by medical gentlemen, who, as a rule (with certainly a few bright exceptions), are generally unfitted, through want of proper training, to fill the office.

In the interest of society at large, and of the chemical profession itself, it is very desirable that the whole subject should be thoroughly discussed in its various aspects: and, in my opinion, there is no more suitable medium for doing so than the columns of your valuable journal, which, occupying as it does, the first position in English chemical periodical literature, is presumably read by all persons who may be supposed to be interested in this subject.

Seeing how small is the amount of information on "food analysis," of any real practical value, at present available, there can be no doubt that a series of essays on the subject, appearing in the CHEMICAL NEWS, and written either by yourself or by some other competent authority, would be of very great value at the present time, and they would be highly appreciated by very many of your readers, myself among the number.—I am, &c.,

WILLIAM RATCLIFFE.

Wolverhampton, Dec. 2, 1873.

[Such a series of essays is in preparation, and will shortly commence.—ED. C. N.]

ON THE COEFFICIENT OF EXPANSION OF CARBON DISULPHIDE.

To the Editor of the Chemical News.

SIR,—In your report of the meeting of the Chemical Society last week, you represent Professor Foster as saying that there must be an error in my calculations. I am sorry to say that he is perfectly correct; I have inadvertently introduced an error into the formula for calculating the expansion. I make this avowal to prevent any scientific man from being misled by the figures given in your report, but the corrected numbers will be given when the paper is published in the Society's *Journal*. The only excuse I can offer is that I was attempting to do too much, and, when persons have too much business and brain-work all day, they generally find their heads are never so clear at night for calculations.—I am, &c.,

J. B. HANNAY.

Dec 1 1873.

EVOLUTION AS APPLIED TO THE CHEMICAL ELEMENTS.

To the Editor of the Chemical News.

SIR,—In the issue of *Nature* for Nov. 6, Mr. Blanshard has drawn attention to the above subject by a letter, in which he pre-supposes that this theory has not been discussed before.

Allow me to refer him to a letter by the writer, published in your journal (vol. xxiv., p. 131), in which a parallel was drawn between the derivation of the endless variety of plants and animals from one or more simple forms, and the integration of all the so-called chemical elements and compounds from one primordial matter.

Again (vol. xxvi., p. 138), a paper was published by me, on the "Constitution of Matter," in which I sketched some of the considerations leading to the conclusion that from one primordial matter have been developed or evolved all those integrant parts the study of which constitutes the science of chemistry. To substantiate such views it is chiefly necessary to prove the identity of the matter of one element with that of all other elements, and this can best be done, perhaps, by showing that those properties, considered as peculiar to each element respectively, are properties which are determined by a definite expense of force in each case.

I do not wish to engage in any discussion on the matter, but perhaps I may be excused for pointing out that the above views seem to be gaining credit. Thus, at the meeting of the Chemical Society on May 15 last, Dr. Armstrong pointed out that "isomerism" admits of an easy explanation, if it be assumed "that different amounts of force have been expended in the formation of the isomeric compounds," and, as Dr. Mills then stated, it was eight years since he had propounded and published a dynamical theory in explanation of "isomerism"—a theory "parallel to that proposed by Dr. Armstrong. The connection between such views and the evolution of the elements is at once evident.—I am, &c.,

CHAS. T. KINGZETT.

Kensington, W., Nov. 25, 1873.

PHOSPHORUS A TEST FOR IODATES.

To the Editor of the Chemical News.

SIR,—I observe in your "Chemical Notices from Foreign Sources" of Nov. 21 a notice of phosphorus as a reagent for iodates. Without wishing in any way to detract from the author's merit as being the first to publish this reaction, I may yet be permitted to state that I became acquainted with it more than eighteen months ago, while experimenting on the presence of iodate of calcium in sea-water. I made many experiments on the action of phosphorus on the iodates, one of which I find mentioned in my note-book, under date May 3, 1872, and as this particular experiment, referring to the action of *red* phosphorus, has still a shade of novelty, I give it:—"Red phosphorus diffused in water acts, especially when heated, upon iodate of calcium, liberating iodine. The phosphorus, added in excess, with addition of hydrochloric acid, gives a clear colourless liquid." I enclose the leaf, torn from my note-book, containing this account. I used carbonic disulphide, containing a minute proportion of phosphorus dissolved in it, as a confirmatory test for the presence of an iodate in sea-water. But the experiment requires great care in order to get a satisfactory result; for, if the phosphorus is in excess, the carbonic disulphide (containing phosphorus in solution), when shaken up with sea-water, becomes opaque and of a brownish or violet tint, owing to the reduction of some traces of metals from sea-water, which, being collected by the disulphide, give that appearance. With proper care it is, however, possible to get the veritable iodine reaction from sea-water by this test; but the danger of the confounding of the true and the simulated reaction by some who might repeat my experiments without sufficient care,

deterred me from publishing the fact, especially as I gave adequate evidence of the presence of iodate in sea-water without it. Moreover, I intended to make further investigations as to the metals in sea-water which give the reaction referred to, and I have not yet been able to complete these. Hence the delay in publishing the observation I made as to the action of phosphorus on iodates.—I am, &c.,

E. SONSTADT.

Ramsay, Isle of Man, Nov. 24, 1873.

HYDROGEN AND SOLUTION OF NITRATE OF SILVER.

To the Editor of the Chemical News.

SIR,—Dr. Williamson's assertion that the solubility of hydrogen in water diminishes with rise of temperature, will probably surprise those of your readers who happen to have read Bunsen's admirable text-book on gas-analysis.

According to Bunsen, the solubility of hydrogen in water is the same for a wide range of temperature (the coefficient of solubility being 0·019.) According to Bunsen hydrogen is distinguished from most other well-known gases by the constancy of this coefficient.

Whether Dr. Williamson's remark touching the solubility of hydrogen was made at random, or whether it was a record of unpublished experiments of his own, I am unable to determine. Dr. Williamson's statement that hydrogen is more soluble in solution of nitrate of silver than in water; and his suggestion that some chemist should make a measurement of the solubility of hydrogen in nitrate of silver, during the interval between the commencement of the passage of gas through the liquid and the first appearance of precipitation, calls for comment. It will be evident that, on the assumption that the first action of hydrogen is to reduce nitrate to nitrite of silver, the resulting nitrite cannot make its appearance until sufficient nitrite has been formed to saturate the solution. The experimenter who overlooks this fact will be in danger of calculating the hydrogen which has combined with oxygen as if it were existing in solution in the nitrate of silver.

For my own part I am inclined to doubt whether solution of nitrate of silver *dissolves* more hydrogen than water does; and I should advise caution on the part of any young chemist who is disposed to follow Dr. Williamson in this matter.

J. ALFRED WANKLYN.

Dec. 1, 1873.

MISCELLANEOUS.

The Royal Society.—At the annual meeting of the Royal Society, held at Burlington House on December 1, the following gentlemen were appointed officers and council for the ensuing year:—*President*—Joseph Dalton Hooker, C.B., M.D., D.C.L., LL.D. *Treasurer*—William Spottiswoode, M.A., LL.D. *Secretaries*—Prof. George Gabriel Stokes, M.A., D.C.L., LL.D.; Prof. Thomas Henry Huxley, LL.D. *Foreign Secretary*—Prof. Alexander William Williamson, Ph.D. *Other Members of the Council*—Sir George Biddell Airy, K.C.B., M.A.; Sir B. C. Brodie, Bart., M.A., D.C.L.; Professor Arthur Cayley, LL.D.; John Evans, Sec. G.S., F.S.A.; Daniel Hanbury, Treas. L.S.; Nevil Story Maskelyne, M.A.; Prof. James Clerk Maxwell, M.A.; C. Watkins Merrifield, P.R.S.N.A.; Joseph Prestwich, V.P.G.S.; Andrew Crombie Ramsay, LL.D.; Rear-Admiral G. H. Richards, C.B.; Prof. George Rolleston, M.D., M.A.; J. S. Burdon Sanderson, M.D.; William Sharpey, M.D., LL.D.; Francis Sibson, M.D.; Major-General R. Strachey, R.E., C.S.I. After the anniversary dinner, the Fellows of the Society adjourned to their new apartments at Burlington House.

Public Analyst.—Professor Alfred Anderson, Public Analyst to the Vestry of St. Martin-in-the-Fields, and Professor of Practical Chemistry in Queen's College, Birmingham, has been appointed Public Analyst to the Board of Works for the Poplar District.

Physical Society.—A preliminary meeting was held on Saturday last, in the Physical Laboratory of the Science Schools, South Kensington, to consider the formation of a Physical Society. The chair was taken by Dr. J. H. Gladstone, F.R.S. Thirty-six gentlemen were present, including most of the Physicists of London. It was resolved that the following gentlemen be requested to serve as an organising Committee:—W. G. Adams, E. Atkinson, W. Crookes, A. Dupré, G. C. Foster, J. H. Gladstone, T. M. Goodeve, F. Guthrie, O. Henrici, B. Loewy, Dr. Mills, A. W. Reinold, and H. Sprengel. A letter was read from the Lords of the Committee of Council on Education, granting the use of the Physical Laboratory and Apparatus at the Science Schools, South Kensington, for the purposes of the Society.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in utilising alkali waste in the manufacture or production of building materials. J. Buchanan, manufacturing chemist, Hebburn, Durham. March 1, 1873.—No. 752. The invention consists in combining the waste with sand, gravel, rock, slag, waste glass, ashes, or other similar materials. The combination is effected by grinding the materials together, and the compound is moulded into bricks or blocks or used as a cement.

Improvements in the manufacture of soda and potassa. James Hargreaves, chemist, Widnes, Lancaster, and T. Robinson, iron-founder, of the same place. March 3, 1873.—No. 764. This consists in heating a mixture of sulphate of soda or potassa with carbonaceous matter and metallic oxide or oxides to a point short of fusion. The mass is then cooled without exposure to the atmosphere and lixiviated.

An improvement in dyeing and fixing of what are known as aniline colours. Edward Hunt, professional chemist, Worsley Street, Salford, Lancashire. March 3, 1873.—No. 766. This Provisional Specification describes dyeing and fixing aniline colours upon cotton and linen yarns and fabrics with a mordant composed of an aluminous salt combined with gelatin and tannin.

Improvements in treating catechus, cutch, or gambier, to obtain products therefrom suitable for use in tanning, dyeing, and printing. Edward Hunt, professional chemist, and George Manley Hopwood, both of Worsley Street, Salford, Lancashire. March 4, 1873.—No. 783. This provisional specification describes treating the catechus, cutch, or gambier so as to separate the material so treated into two products, the one suitable to the requirements of the tanner, and the other to the requirements of the dyer and printer.

Improved processes for the extraction of iodine. Bristow Hunt, Serle Street, Lincoln's Inn, Middlesex. (A communication from Alvaro Francisco Carlos Reynoso, Paris.) March 5, 1873.—No. 799. This invention comprises the following processes:—(A.) Three processes for the extraction of the iodine contained in iodates, applicable to the extraction of the iodine contained in the mother waters, of the treatment of "caliche" in the mother waters, of the purification of American nitrates, and other similar products. (B.) Two processes for the extraction of the iodine contained in the form of iodide.

NOTES AND QUERIES.

Sulphide of Sodium in Black-Ash.—Would any reader please say what is the readiest method for estimating the above for manufacturing purposes where many samples are examined daily?—A SUBSCRIBER.

Vanadium in Iron Ores.—Can anyone inform me of a reliable method of estimating quantitatively the amount of vanadium in iron ores or pig-iron?—S. P.

TO CORRESPONDENTS.

ERRATUM.—In CHEMICAL NEWS, vol. xxviii., p. 277, col. 1, *for* "G. Bulk Francis," *read* "George Bult Francis."

BOOKS RECEIVED.

Quantitative Chemical Analysis. By Dr. C. Remigius Fresenius. Sixth Edition; Translated by A. Vacher. J. and A. Churchill.

Elderhorst's Manual of Qualitative Blowpipe Analysis and Determinative Mineralogy. Edited by Henry Nason, Ph.D., and Charles F. Chandler, Ph.D. Philadelphia and London: T. Ellwood Zell.

CHEMICAL TEXT-BOOKS.

Chemistry, Inorganic and Organic.

By C. L. BLOXAM, Professor of Chemistry in King's College, London. Second Edition, with 295 Engravings on Wood, 8vo., 16s.

By the same Author,

Laboratory Teaching; or, Progressive

Exercises in Practical Chemistry. Second Edition, with 89 Engravings, crown 8vo., 5s. 6d.

Introduction to Inorganic Chemis-

TRY. By W. G. VALENTIN, F.C.S., Principal Demonstrator in the Science Training Schools. With 82 Engravings, 8vo., 6s. 6d.

By the same Author,

A Course of Qualitative Chemical

ANALYSIS. With 19 Engravings, 8vo., 7s. 6d.

Also,

Tables for the Qualitative Analysis

of Simple and Compound Substances, both in the Dry and Wet Way. On indestructible paper, 8vo., 2s. 6d.

First Principles of Modern Chemis-

TRY. A Manual of Inorganic Chemistry for Students, Schools, and Science Classes. By U. J. KAY-SHUTTLEWORTH, M.P. Second Edition, crown 8vo., 4s. 6d.

Handbook of Volumetric Analysis;

or, the Quantitative Estimation of Chemical Substances by Measure. By FRANCIS SUTTON, F.C.S., Norwich. Second Edition, with Engravings, 8vo., 12s.

Instruction in Chemical Analysis.

By C. REMIGIUS FRESENIUS. Edited by ARTHUR VACHER.

QUALITATIVE. Eighth Edition, 8vo., 12s. 6d.

QUANTITATIVE. Sixth Edition, 8vo., 18s.

In Two Volumes, with 123 Plates, containing 350 Figures, 8vo., 24s.,

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E. KLEIN, M.D., Assistant-Professor in the Pathological Laboratory of the Brown Institution

J. B. SANDERSON, M.D., F.R.S., Professor of Practical Physiology in University College, London;

MICHAEL FOSTER, M.D., F.R.S., Fellow of, and Prælector of Physiology in, Trinity College, Cambridge;

T. L. BRUNTON, M.D., D.Sc., Lecturer on Materia Medica in the Medical College of St. Bartholomew's Hospital.

Edited by J. BURDON-SANDERSON.

"Its publication is a stimulus to physiology, and we shall soon expect to see fruit in the shape of substantial work done by many of our younger physiologists."—*Journal of Anatomy and Physiology.*

"The student is conducted by a regular and carefully considered scheme from the observation of the simplest objects to the interpretation of the most complex phenomena that occur in the body. . . . The performance of the experiments in the book will give him so thorough a knowledge of physiology as shall stand him in good stead in whatever branch of medical practice he shall hereafter be engaged. . . . The book is perfectly unique, and will prove of equal value to both students and teachers."—*Lancet.*

With Engravings, 8vo., 12s.,

An Introduction to Physical Mea-

SUREMENTS; with Appendices on Absolute Electrical Measurement, &c. By Dr. F. KOHLRAUSCH, Professor at the Grand Ducal Polytechnic School at Darmstadt. Translated from the Second German Edition by T. H. WALLER, B.A., B.Sc., and H. R. PROCTER, F.C.S.

"It will be invaluable."—*Quarterly Journal of Science.*

"The issue of this work, and its translation into English, is an event of so high importance that too great stress can scarcely be be brought to bear."—*Telegraphic Journal.*

Fownes' Manual of Chemistry.

Edited by HENRY WATTS, B.A., F.R.S. Eleventh Edition, with Engravings and Coloured Plate, crown 8vo., 15s.

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ANALYSIS. By JOHN E. BOWMAN. Edited by C. L. BLOXAM. Sixth Edition, with Engravings, fcap. 8vo., 6s. 6d.

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being a Syllabus of Chemistry and Practical Chemistry. By ALBERT J. BERNAYS, Professor of Chemistry at St. Thomas's Hospital. Fifth Edition, fcap, 8vo., 3s. 6d.

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SUPPLEMENT
TO
THE CHEMICAL NEWS.

Vol. XXVIII. No. 732.

THE EXAMINATION OF BLOOD-STAINS.

A commission, composed of MM. Mialhe, Mayet, Lefort, and Cornil, have furnished an interesting report on this subject (*Répertoire de Pharmacie*, July 10th, 1873; *Progrès Medical*, August 23). They point out that in the present day it is no longer possible, in the examination of blood-stains in legal medicine, to rest satisfied with the physical characters observed by the naked eye. The microscope, sometimes alone, but more often associated with chemical analysis and the spectroscope, enables us to obtain an exact diagnosis formerly impossible in a great number of cases. Two conditions may occur.

1. When the stain is of recent date, or supposed to be so, the red corpuscles should be particularly examined, and every care taken to preserve them without change. The stains must not be washed with water, so that the hæmatin may not be altered. After insisting on the microscopic characters of the blood-stains, isolated or compared with those of various animals, the commission enumerate with care the fluids which are destructive or preservative of blood-corpuscles. Among the first, water, and particularly hot water, acetic, gallic, hydrochloric, and sulphuric acids; and of alkalies, potash and soda, even in weak solution, and ether and chloroform, and many other reagents, so alter the blood-corpuscles as to cause them to entirely disappear. Alcohol, chromic and picric acids, and bichromate of potash, preserve the corpuscles, though they alter their form. The preservative fluids are those whose composition approach nearest to serum, such as the iodised serum of Schultze, an excellent preparation, made with amniotic fluid, to which are added a few drops of the tincture of iodine, so as to give it the colour of white wine; or better, a fluid composed thus—white of egg, 30 grammes; distilled water, 270 grammes; and chloride of sodium, 40 grammes; or even a fluid containing 0·5 per cent of chloride of sodium, or 5 or 6 per cent of sulphate of soda. If the stains be wetted and softened by these fluids and then examined, white and red corpuscles and fibroid particles will be observed.

2. In more difficult cases, when the microscope, owing to the alterations which time has effected in the hæmatin, can give but vague information, examination by the spectroscope and chemical analysis enable us to arrive at precise results. The use of these means, being less known and also more delicate, requires special study.

1. *Spectrum Analysis.*—Colouring matters have the power of absorbing certain coloured rays of white light—the same always for the same substance. This is the principle on which spectroscopic examination is based. If into an analysing tube filled with water a few drops of a solution of hæmoglobin be introduced till it has the colour of peach-blossoms, the luminous rays of the spectrum passing through this fluid present two bands of absorption between the lines D and E of Frauenhofer in the yellow and the green. The same fact would be observed if a few drops of blood were substituted for hæmoglobin in the analysis. In a case of doubt, the hæmoglobin of the blood could be reduced by adding to this latter a reducing body. Destroyed hæmoglobin has a different spectrum from oxygenated hæmoglobin; a single absorption-band as large as the two former bands united, and a little to the left of Frauenhofer's line D.

2. In blood in a state of decomposition, or which has been treated by acids or caustic alkalies, hæmoglobin is changed into a new substance; hæmatin is formed, which, combined with hydrochloric acid, gives characteristic crystals. In order to obtain them, we must proceed thus. A small fragment of dried blood is placed on a glass slide; it is dissolved in a drop of water, and a minute portion of sea-salt is added. It is covered with a thin slide, and pure acetic acid is made to pass between the two slides, and it is heated over a spirit-lamp to boiling-point. Acetic acid is again added, and it is heated afresh, and this is repeated till the crystals are obtained. They are rhomboidal, of a dirty brown colour, quite characteristic, and require to be seen with a magnifying power of three hundred or four hundred diameters. With the smallest quantity of blood these two reactions can always be produced—the spectrum examination and the crystals of hydrochlorate of hæmatin; and they are so certain, that the existence of one alone enables one to affirm the presence of blood.

3. The third process, though not so exact as the preceding, ought nevertheless not to be neglected. If to a very small quantity of blood dissolved in a little water be added a few drops of tincture of guiaicum and of binoxide of hydrogen, a persistent blue colour is immediately produced; but this very sensitive reaction can be obtained with other organic matter, nasal mucus, saliva, &c.; it therefore only gives a probability. We must proceed in the following manner. A tincture of guiaicum is prepared with alcohol at 83 degrees, and guiaicum resin; a mixture of sulphuric ether and binoxide of hydrogen is also made, and enclosed in a stoppered bottle, and kept under water in the dark. This preparation is less liable to change than pure oxygenated water. The object stained with blood, if it be white, is put into a little cup, then moistened with water to dissolve out the blood-stain, and washed in distilled water; this water is then submitted to the action of these reagents. If the thing stained be coloured, and the stain little or not at all visible, it must be moistened and then pressed between two or three sheets of white blotting-paper, and tried first with the guiaicum. If the stain be of blood, a reddish or brown spot will form on the paper. One of the sheets should be treated with ammonia, and the stain will become crimson or green. A second sheet, treated with tincture of guiaicum and ozonised ether, will give a blue colour more or less intense, according to the quantity of the blood.

To recapitulate: 1. If the stains or scales of blood appear recent, the corpuscles may, after the necessary precautions, be examined under the microscope, and their presence, diameter, &c., observed, which will enable one to diagnose the origin of the blood, whether human or animal. 2. If the stains be old and the blood changed, the reaction with the tincture of guaiacum would make the presence of blood probable; but its actual presence cannot be affirmed without spectrum examination, or the production of crystals of hydrochlorate of hæmatin: one of the two is sufficient. It is unnecessary to add that these reactions do not show whether the blood is human or animal.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, December 1st, 1873.

George Busk, F.R.S., Treasurer and Vice-President, in the Chair.

The following Letter to the Family of the late President was unaminously adopted by the Members present:—

"The Members of the Royal Institution beg to be permitted to express to the family of their late President, Sir Henry Holland, their deepest sympathy in the great loss they have recently sustained. It is a loss in which the Institution largely shares; and it has to deplore a President esteemed by all for his distinguished scientific and literary attainments, for the abilities and varied experience he brought to the performance of his duties; and beloved for the uniform kindness and consideration with which he discharged them. In the published record of his life Sir Henry Holland has acknowledged that his connection with the Royal Institution had been very valuable to him It is now for the Members of the Institution to testify their profound sense of the exceeding advantages conferred by that association upon the Royal Institution. In it, as he himself has related, he stood by the cradle of some of the most wonderful discoveries of the age, and watched their progress to maturity and fame. He was one of the earliest to witness the production of the alkaline metals by Davy, and among the first to see the small luminous spark elicited from the magnet by Faraday. In later times he was foremost in establishing the Royal Institution Research Fund, and was unceasingly generous in his own large personal contributions to it. As President he was always at his post, ever prompt with assistance and counsel; a sound adviser and a courteous friend. The recollection of his presence in the Institution will not soon be forgotten, and will long remain to be cherished by its Members with affection and regard. The close of such a career must be noted with no ordinary feelings of interest and regret, and the Members of the Royal Institution desire to assure the family of their lamented President how fully they enter into the universal sorrow for his death."

Mrs. Walter Fawcett, and Mr. Charles Craddock Underwood were *elected* Members of the Royal Institution.

The Duke of Northumberland, D.C.L., was unanimously elected President of the Royal Institution, in the room of the late Sir Henry Holland.

The following lecture arrangements for the ensuing season were announced:—

Christmas Lectures (adapted to a Juvenile Auditory).

Professor Tyndall, D.C.L., LL.D., F.R.S. Six lectures on "The Motion and Sensation of Sound," on Dec. 27 (Saturday), Dec. 30, 1873; Jan. 1, 3, 6, 8, 1874. Before Easter, 1874.—Professor Rutherford, M.D., F.R.S.E. Eleven lectures "On the Nervous System," on Tuesdays, Jan. 13 to March 24. Professor P. M. Duncan, F.R.S. Seven lectures "On Palæontology, with reference to Extinct Animals and the Physical Geography of their Time," on Thursdays, Jan. 15 to Feb. 26. Professor W. C. Williamson, F.R.S. Four lectures "On Cryptogamic Vegetation," on Thursdays, March 5 to 26. Professor G. Croom Robertson, University College, London. Four lectures "On Kant," on Saturdays, Jan. 17, 24, 31, and Feb. 7. R. Bosworth Smith, Esq., M.A. Four lectures "On Mohammed and Mohammedism," on Saturdays, Feb. 14, 21, 28, and March 7. Charles Thomas Newton, Esq., M.A., Keeper of Greek and Roman Antiquities, British Museum. Three lectures "On Ephesus," on Saturdays, March 14, 21, and 28.

The Friday Evening Meetings will commence on January 16, at 8 o'clock p.m. The Discourse will begin at 9 o'clock.

Friday Evening Discourses during the Season will probably be given by Professors Tyndall and Sylvester, Sir Julius Benedict, Mr. A. H. Garrod, Dr. Doran, Mr. Vernon Heath, Mr. Francis Galton, Dr. Burdon Sanderson, M. Cornu, Dr. Carpenter, and Professor Ramsay.

Chair of Chemistry Carmichael School of Medicine (Richmond Hospital) Dublin.—C. R. C. Tichborne, Ph.D., F.C.S., M.R.I.A., &c., has been appointed Professor of Chemistry to the above School of Medicine.

NOTICES OF BOOKS.

Les Engrais Perdus dans les Campagnes. (The Manures Wasted in the Country.) Par N. DELAGARDE. Paris: Librarie Centrale d'Agriculture et de Jardinage.

THIS work calls attention, perhaps in a rather more rhetorical style than would be admired in England, to the serious waste of manurial matters taking place in France. This waste is estimated, apparently without exaggeration, at 2 milliards of francs yearly. He considers human excrement to have more than one-and-a-half times the value of sheep's dung, twice that of horse-dung, and three times that of cow-dung. The dejections of an adult person he estimates to have an average yearly value of 28 francs. Poudrette, a form in which night-soil is commonly used in France, he considers to have lost five-sixths of its fertilising properties, a view which we see no reason for disputing if the method of its preparation is fairly considered. It must be noted that the author confines his estimates and recommendations to the rural districts. Of the loss in the towns and of the method of preventing it he does not treat.

Now many persons will be inclined to deny that any waste of manurial matter takes place in the country. They will ask, What can become of the excrements of man and beast if not applied to the land? But, before manures reach the spot where their action is wanted, they are often suffered to lie for a long time fermenting, and allowing their most valuable constituent, ammonia, to "waste its sweetness on the desert air." No less are they injured, in a majority of cases, by the loss of their soluble constituents, such as phosphoric acid, potash, magnesia, &c. It is something quite common, in passing a farm-yard, to notice a driblet of deep brown liquid oozing from the manure heap, and finding its way to the nearest ditch. Hence, after nourishing the weeds along the water-course, it ultimately flows into the same brook and aids in the pollution of our rivers. In like manner, the village cesspools too often will be found draining into the ponds and streams. Thus, though the manure is ultimately carted in due form upon the fields, it is, comparatively, a mere inert residue deprived of its most valuable constituents. The author proposes to arrest such escapes by substituting for the cesspool portable chests, in which the excrement is brought into contact with copperas, sulphate of lime, &c., to fix the ammonia. The contents of these chests can then be regularly withdrawn and applied to the soil. The drainings of dunghills, and the urine, a very large proportion of which runs to waste, both in town and country, he proposes should be carefully collected in appropriate pits or tanks. A mixture which he suggests for absorbing both the volatile and the liquid constituents of excrements is composed of 18 double decalitres of dry earth, powdered and sifted; 3 double decalitres of ashes; 2 double decalitres of gypsum; and 1 double decalitre each of slaked lime and of charcoal dust. In a following section he refers to the waste of dead animals, which are often buried entire in pits. The water in which sheep or parcels of wool have been washed, and the liquid resulting from the retting of flax and hemp, have also considerable manurial value, and, as the author points out, are only used accidentally. He shows that the non-edible fungi, which in some parts of the Continent are very abundant, contain in their moist state about 1·5 per cent of nitrogen, and are consequently well worth collecting as manure. He protests, also, against the burning of straw, by which its nitrogen is dissipated and its mineral constituents thrown into a less available condition. What would be his opinion of a new agricultural steam-engine specially arranged to burn straw, and recommended as a great improvement.

This work, although it does not profess to contain anything new to the agricultural chemist, is likely to be very useful. It calls attention, in a plain, unpretending manner, to losses which, though individually trifling, amount in

the course of a year, and over the extent of a whole country, to sums of national importance, and it points out simple methods for their prevention. The lesson is worth attention on both sides of the Channel.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, October 27, 1873.

Sixth Note on Guano.—M. Chevreul.—The author has found in guano crystals containing three bases—potash, ammonia, and lime combined with oxalic acid. They are soluble in water, and the concentrated solution is not rendered turbid by oxalate of ammonia, even after the lapse of forty hours. If the solution is much diluted with water, and allowed to stand, it loses its transparency and becomes turbid. The opacity is due to the deposition of oxalate of lime. He has also discovered urate of lime in guano. His researches on guano have revealed facts of crystallisation analogous to this, which he communicated to the Academy regarding the salts of dead bodies.

Purification of Hydrogen Gas.—M. Ch. Violette.—The author finds that if hydrogen is prepared from zinc, and purified according to the method of Dumas, it contains no gaseous compounds of carbon. If instead of zinc, iron (whether wrought or cast) be used gaseous hydrocarbons are produced, and accompanying the hydrogen. Whether carbon exists at all as an impurity in zinc is doubtful, if we consider the mode of its extraction.

Sugar Contained in Vine Leaves.—M. A. Petit.—A kilo. of vine leaves yielded 15·8 grms. of cane-sugar, and 17·49 grms. of glucose. A kilo. of peach leaves yielded 33 grms. of cane sugar, and only 12 of glucose.

Reply to a Note of M. Respighi on the Extent of Variations of the Solar Diameter.—P. Secchi.—In opposition to M. Respighi the author finds no difference in results, with the objective prism and with the interposed prism. The small value he obtains for the solar diameter diminishes by five or six seconds the diameter given in the "Nautical Almanack" (32′ 13″±). This result agrees with that of Encke, who gives 31′ 56·8″ and with that of M. Mazzola, lately published in Turin, 31′ 57·3″; the influence of atmospheric oscillation, irradiation, &c., having been eliminated.

Researches on Crystalline Dissociation; Evaluation and Distribution of Work in Saline Solutions. (Continued.)—MM. Favre and Valson.—When salts of strong acids are dissolved in sufficient water there is established in the liquor, and between the elements of the salts, an equilibrium such that each of the metalloidic radicals may be supposed associated with one of the metallic radicals, and reciprocally. This appears specially from the observation of phenomena of *thermo-neutrality*, which has been deduced from the existence of thermal modules. Having studied the question as regards variations of volume accompanying the phenomena of solution, the authors find that the densities of saline solutions have relations of a similar nature. There are modules of density as there are thermal modules; and there is a *neutrality* with reference to density as with reference to heat. The authors, for convenience sake, designate this *densi-neutrality*.

New Process of Condensation of Liquefiable Matters Held in Suspension in Gas. (Reply to M. Colladon.)—MM. Pelouze and Audouin.—The authors state that the novelty in their invention is the reflecting condensation in the dry state, by simple shock of finely-divided liquefiable matters without the intervention of water, or of any liquid solutions, and without cooling surfaces, both of which M. Colladon employs.

Results of Experiments made at Hyéres on the Destruction of Phylloxera by Sulphide of Carbon.—M. Bazille.—The entire cost of treating each stock is estimated at not over 50 centimes.

Action of Condenser on Induction Currents.—Lecoq de Boisbaudran.—While physicists generally admit (the author thinks) that the spectral modifications, produced by introduction of a Leyden jar into the induced circuit, are due to variations of the temperature, and not to any particular alteration in the physical nature of the discharge, he yet offers some remarks in support of this view:—1. One may observe the thermal superiority of the condensed spark over the ordinary spark on comparing together the spectra obtained, under different conditions, by means of the same substance. 2. The effects of the condenser being due to increase of temperature, there is gradual passage from the spectra obtained with the aureole of the ordinary spark to those when a powerful Leyden jar is employed. 3. The action of the condenser does not appear the same in different spectra. 4. The different lines of the same spectrum are not always equally affected by the condenser. 5. The lines intensified by the condenser become nebulous and enlarged. 6. The broadening of narrow lines at high temperature is explained by the perturbations undergone by the molecular movements, when the forces applied are considerable. 7. The lines of emission of solid or liquid substances are nebulous. 8. It seems necessary to distinguish two kinds of continuous spectra proceeding from those of the second order, viz., (*a*) spectra, the lines of which are enlarged by increase of temperature; (*b*), those, the lines of which owe their enlargement to the little freedom of the molecules. If, as it seems, there is sometimes a gradual transformation of the shaded bands of a spectrum of the first order into the narrow ones of one of the second order, it is in consequence of an increase of temperature. 9. The sparks of different induction coils present spectral differences to the inequality of the temperatures developed.

Liebig's Annalen der Chemie und Pharmacie. October 4, 1873.

On Bromtoluols and the Behaviour of their Hydrogen Atoms. (Part I.)—H. Hübner and J. Post.—A lengthy treatise, extending to 66 pages. The authors, who have been assisted in their researches by Retschy, Hässelbarth, Weiss, Terry, and Müller, treat firstly of crystalline para-brom-toluol and its derivatives, such as *α*-para-brom-sulphi-toluol, *α*-para-brom-sulphi-nitro-toluol, *α*-para-brom-sulphi-benzoic acid, *β*-para-brom-sulphi-toluol, *β*-para-brom-sulphi-nitro-toluol, *β*-para-brom-sulphi-benzoic acid, ortho-sulphi-toluol, and toluol-sulph-hydrate. Liquid ortho-brom-toluol is next examined, with its derivatives, ortho-brom-sulphi-toluol, ortho-brom-sulphi-nitro-toluol, ortho-brom-sulphi-benzoic acid, and meta-sulphi-toluol. In succeeding chapters, the authors show the place of the sulphi group in the crystalline brom-toluol, the inability of the isomeric derivatives of brom-toluol to pass into each other by the action of heat, on the position of the constituents in the brom-toluols formed from bromine and toluol, on uniformities in the proportion of crystalline water, on molecular combinations, and on quantivalence.

Determination of Nitrogen.—S. W. Johnson.—This proposal to use sulphate of soda to replace hydrate of soda in soda-lime has been already noticed.

On Atacamite.—E. Ludwig.—Theoretical considerations on the constitution and possible formula of atacamite, with remarks on brochantite.

Nitro-Derivatives of Naphthalin.—F. Beilstein and A. Kuhlberg.—The authors enter upon an examination of mono-nitro-naphthalin, α and β-dinitro-naphthalin, α-amido-nitro-naphthalin, its sulphate, and mono-nitro-naphthalin reproduced from it. They did not succeed in obtaining a β-diamido-naphthalin. They produced trinitro-naphthalin in four modifications, α, β, γ, and δ, and lastly α and β-tetra-nitro-naphthalin.

Action of Sulpho-Carbonyl-Chloride upon Amides. B. Rathke and P. Schäfer.—It is well known that sulpho-carbonyl-chloride has the property of converting aniline and the amides of the alcohol-radicals into mustard-oils. The authors attempted to prepare two new classes of these oils by means of amido-benzoic acid and benzamide. From the former they obtained a mustard-oil benzoic acid, $CSNC_6H_4CO_2H$, but with benzamide they were unsuccessful in their attempt to form a benzoylic oil of mustard.

On Dibenzamide.—P. Schäfer.—In the experiments referred to in the last-mentioned paper, the author obtained a dibenzamide crystallising with two equivalents of water, $NH(C_7H_5O)_2+2H_2O$.

On a Polyaceton.—W. Heintz.—The substance in question has the same composition as aceton, but its higher boiling-point proves that its molecule is larger than that of aceton. The author takes it to be the analogue of the duplo-sulph-aceton of Wislicenus.

Preparation of Alanin by Means of Cyanide of Potassium, and on Lactyl Urea obtained as a By-Product.—W. Heintz.—Strecker, to obtain alanin, mixes two parts of aldehyd-ammonia with one of hydrocyanic acid, both in the state of aqueous solution, adds to the mixture hydrochloric acid in excess, and evaporates in the water-bath. Heintz proposes to use cyanide of potassium in place of hydrocyanic acid. He also examines the reactions and combinations of lactyl urea.

Constitution of Natural Silicates.—Dr. K. Haushofer.—A purely hypothetical paper.

On the Polydenes, and on the Transformation of Ethylen into Ethyl-Alcohol.—W. Goriainow and A. Butlerow.—The authors set out with the object of polymerising ethylen. In this they were not successful. Alcohol was obtained in quantity by passing ethylen into concentrated sulphuric acid heated to from 100° to 175°, distilling the acid liquid with a plentiful addition of water, and treating the distillate with potash.

Protein Substances. (Second treatise.)—H. Hlasiwetz and J. Habermann.—The authors saw reason to admit a relation between these bodies and the hydrates of carbon. On treating casein with dilute hydrochloric acid and chloride of tin, the authors obtained glutaminic acid, leucin, and tyrosin, asparaginic acid and ammonia. No hydrates of carbon nor derivatives of such bodies appeared, whence the view stated at the outset of the paper cannot be maintained.

Compounds Belonging to the Camphor Group.—J. Kachler.—The author examines pimelic acid and its ammonium, calcium, barium, magnesium, copper, and silver salts, pimelic ethyl-ether, anhydrous pimelic acid, chloride of pimelic acid, sulpho-camphylic acid, its lead salt, and its behaviour with nitric acid, and concludes with hypothetical speculations on the constitution of certain members of the camphor group.

Isomeric Amylens obtained from the Amylic Alcohol of Fermentation.—F. Flavitzky.—A preliminary notice. The author mentions the following peculiar reaction: if ethylamylic ether is treated with anhydrous phosphoric acid, and the product condensed in a well cooled receiver, a liquid is obtained, which boils at 35°, and which is probably amylen.

Synthesis of Anthracen and of Dimethyl Anthracen.—W. A. van Dorp.—Benzyl-toluol, prepared according to Zincke's directions, and having a constant boiling-point of from 275° to 277°, was passed through an ignited tube filled with pumice stone, and became converted into anthracen, which when pressed and re-crystallised from glacial acetic acid is pure. It melts at 213°, and contains—

Carbon	94·38
Hydrogen	5·86
	100·24

It was capable of conversion into anthrachinon and alizarin by the ordinary methods.

On Cœrulignon and its Derivatives.—C. Liebermann.—This paper is unsuited for abstraction; the author gives for cœrulignon the formula $C_{16}H_{18}O_6$, and shows that it is probably a chinon.

On Penta-brom-resorcin and Penta-brom-orcin.—C. Liebermann and Aug. Dittler.—The authors confirm the formula given by Dr. Stenhouse for the former body, $C_6HBr_5O_2$.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxii., No. 11, November 13, 1873.

M. E. J. Maumené states that he has discovered two great laws by means of which it becomes possible to calculate the totality of any chemical action whatsoever. He expounds his views at length in a periodical, entitled *Petites Annales de Chemie*. He pronounces the idea of substitution "one of the most fatal ever introduced into science."

No. 12.

This number contains a highly eulogistic notice of the late Dr. Calvert, who was well known in French scientific circles. There is otherwise nothing calculated to interest the chemical reader.

Reimann's Färber Zeitung, No. 42, 1873.

Vat for Woollen Dyeing with Zinc-Powder.—For a vat of 500 litres, dissolve 30 lbs. of soda crystals in water, add 2 lbs. of ground indigo, and 15 lbs. of powdered zinc. The whole is stirred well together, adding 15 lbs. of ammonia (? the strength), and a solution of 1½ lbs. of carbonate of ammonia. The whole is once more well stirred, allowed to settle, and heated to 40° to 50° R. It is immediately ready for dyeing. For every pound of indigo added subsequently there are required ½ lb. of zinc-powder, 2 lbs. of soda, 1 lb. of ammonia, and ¾ ozs. of carbonate of ammonia.

The Royal College of Science (Ireland).—We announce with gratification that Professor Galloway has been appointed Dean of the Royal College of Science for the year; and that the Lords of the Committee of Council on Education have decided to amalgamate the Professorships of General and Applied Chemistry in the College, and conferred the joint Professorship upon Mr. Galloway. These changes are the result of the retirement of Sir Robert Kane, the promotion of Dr. Sullivan, and the death of Dr. Barker. The reward bestowed upon Mr. Galloway is only a fair, and too long delayed, recognition of his eminence as a philosophical and practical teacher, and of the zeal and energy he has applied to his duties in the College of Science, and the striking success that has attended the performance of them. The arrangement now made will be for the benefit of the institution, in the prosperity of which the Irish public are so much interested. —*Morning Mail.*

THE CHEMICAL NEWS.

VOL. XXVIII. No. 733.

THE ATOMIC THEORY.

By C. R. A. WRIGHT, D.Sc.

A CORRESPONDENT adopting the signature "Atom" distinguishes, in your columns, between the atomic theories of Leucippus and Dalton, stating that "the first is open to discussion, and will long be, ... the second . . . . is not. We must learn much concerning matter before we can say with certainty that it consists *primarily* of indivisible particles or atoms." He also states that, in writing his paper, he seeks "only to make an arrangement in discussing the Daltonian chemistry."

From the tenour of his note, it would seem that "Atom" does not look upon the views propounded by Dalton, and subsequently extended by others in quite the same light as other writers. Dalton himself ("New System of Chemical Philosophy," Manchester, 1808, p. 213) states that "it is one great object of this book to show the importance and advantage of ascertaining *the relative weights of the ultimate particles both of simple and compound bodies*;" and throughout the work the terms "atom" and "ultimate particle" are used perfectly interchangeably. On page 141 Dalton puts forth his hypothesis thus: "All bodies of sensible magnitude, whether liquid or solid, are constituted of a vast number of extremely small particles, or atoms, of matter."

Later writers have almost uniformly attributed to Dalton the credit of adopting Leucippus's hypothesis, and making it account for the facts (first brought to light by him, *i.e.*, Dalton) of combination in multiple proportion. Gmelin ("Handbook," vol. i., p. 145) states that, "according to the *atomic, corpuscular theory*, matter is an original essence, and consists of certain very small parts, called atoms, molecules, or particles." . . . . In the ancient atomic theory "the atoms are supposed to be actuated, not by any attractive force, but by a motion existing from all eternity (Leucippus, Epicurus, Democritus, Lucretius, Lesage);" according to the modern atomic theory (of Dalton and his disciples), "the atoms are supposed to be impressed with innate forces which give rise to the mutual attraction."

The difference between these theories, *quoad* the final indivisibility of matter, is *nil*. On the other hand, a meaning has been latterly attached to the term atom wholly different from that applied to it by Leucippus, Dalton, and modern physicists, *e.g.*, Clerk-Maxwell, Lecture on Molecules to the British Association, Bradford Meeting (*Nature*, Sept. 25, 1873, p. 437). The transition is thus indicated by Dr. Odling (Watts's "Dictionary," article on "Atomic Weights"): "At the present day, the word 'atom' is most generally employed by chemists [in contradistinction to the term 'proportion' used by Davy]; but, while some use it in its strict Daltonian materialistic sense, others use it in an abstract sense, only to express the smallest indivisible combining proportion of a body, and consider the proportional number of a body as an ultimate or unexplained property pertaining to it." From the general tenour of "Atom's" note, it would seem as though he attributed to Dalton the views really propounded by later chemists, and thus expressly stated to be entirely different from the ideas conceived by Dalton himself as to the meaning and application of the term *atom*.

A careful comparison of the writings of modern chemists on this subject leads to the conclusion that many of these chemists admit that the question of the actual existence of the Leucippus- Epicurus- Dalton- Clerk-Maxwell-ian ultimate particle or atom is in no way raised in chemistry; it may, indeed, be assumed, as when Kekulé accounts for the identity of 1·2 and 2·3 benzin derivatives by assuming a peculiar kind of vibratory motion amongst the hydrogen and carbon atoms constituting the benzin ring, or when the chemist attempts to account for the fact of combination in multiple proportions. But it is not a necessary condition; on the contrary, numerous arguments tend to show (and not the least, Norman Lockyer's most recent researches) that the hypothesis that sixty-five or more essentially different kinds of atoms exist is not in accordance with the whole range of known facts. To bring this forward somewhat pointedly has been the sole object of the writer's papers on this subject heretofore.

The *atom* now referred to by many chemists is not the same thing as the atom of Leucippus, Dalton, and other physicists; the term connotes wholly different ideas. What is described by these chemists as the "atomic theory" is in fact neither a theory nor is it atomic; *i.e.*, it does not involve the assumption of any proposition incapable of experimental proof (such as the assumption that matter is constituted in a particular way), nor does it refer to the special proposition of the existence of ultimate indivisible particles. It might with more justice be called the *greatest common divisor system*, inasmuch as fundamentally it is a system for co-ordinating chemical facts based upon the ascription to the various elements of numerical values, which are the greatest common divisors of the weights of the various elements obtainable from constant bulks of their gaseous compounds respectively.

The atom of Leucippus and Dalton has no longer a place in this system of chemistry, saving in special cases where it is referred to as a means of explaining the facts collected together in the system. Let the chemists who admit that the question of the actual ultimate indivisibility of matter is not raised in chemistry generally, also agree to use no terms which imply the raising of the question and its mental decision in the affirmative. Let the terms atom, molecule, atomic weight, &c., &c., be replaced by words not involving by implication the assumption, so that these terms may revert to their legitimate use as employed by the physicist; then will the reasoning of such chemists be less unphilosophical and illogical than it often is at present, whilst the student will be spared much mental confusion, and there will be less room for controversy based on misapprehensions as to the meanings attached to the words employed.

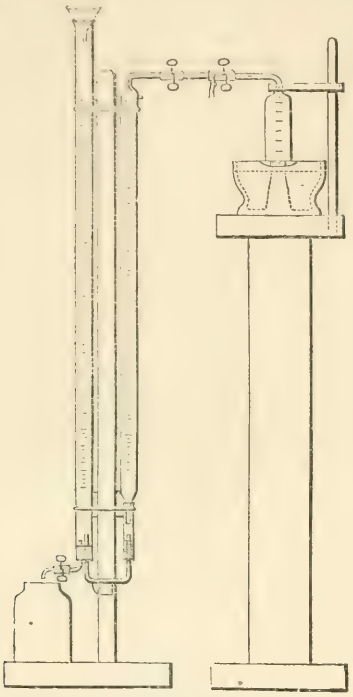
A SIMPLE AND CHEAP APPARATUS FOR THE ANALYSIS OF GASES.

By T. BEESLEY, F.C.S.

FOR some time past I have used a little apparatus for gas analysis, which is so readily constructed from the ordinary materials of the laboratory, is so easy of manipulation, and so satisfactory in its results, that I am induced to bring it to the notice of other chemists.

The apparatus, like that of Regnault, of which it is a modification, consists of two parts:—A laboratory vessel and its trough, in which to receive the gas and submit it to the action of absorbents; and a graduated tube and its adjuncts, in which it is measured and, if necessary, exploded. The laboratory vessel is a cylinder, about 3½ ins. high, and 2 ins. in diameter, holding about 70 c.c. It is drawn out at the top, and a piece of stout thermometer-tube with a fine cylindrical bore, 3 ins. in length, is fused upon it, and bent at a right angle a little above the junction. The measuring-tube is about 20 ins. long, and ½ in. in internal diameter, and has another similar piece of thermometer-tube attached in the same way to its upper extremity, and bent in the same way. Its lower end is drawn out, so as to allow of a double caoutchouc connector being firmly tied or wired upon it. To the other end of this connector a glass tube, bent twice at right angles, and with the limbs 1½ ins. apart, is fastened in like manner, leaving about ½ in. between the ends of the two glass tubes. The second

limb passes through a cork firmly thrust into a piece of combustion-tube 4 or 5 ins. longer than the measurer, and projects ½ in. above the cork, the aperture being contracted. The cork carries another bit of right-angle tube, which, with a caoutchouc connector and spring-clamp, forms a mercury-tap. Both tubes are fixed by means of wire and a few slices of cork to the opposite sides of a square mahogany rod mortised into a solid foot. The measurer has platinum wires fused into it just below the top, and is carefully graduated into cubic centimetres and tenths, or has a millimetre scale etched upon it, and is then calibrated. In the latter case, a millimetre scale is also scratched upon the filling- or pressure-tube, to assist in the adjustment of the mercury-level. If the tube is graduated for capacity, a similar scale may be laid down upon paper pasted to the front of the support. The capillary-tube of the measurer has another bit of thermometer-tube, 2 ins. long, joined to it by a good caoutchouc connector, leaving the ends of the



tubes ¼ in. apart, so that it may be closed by a spring-clamp. This space may with advantage be occupied by a piece of smaller caoutchouc tube fitting tightly into the larger one. The tube of the laboratory vessel is also provided with a similar connector, which, in use, is slipped over the middle tube, and secured by a few turns of twine. A clamp closes this junction also.

In using the apparatus. an ordinary porcelain mercury-trough is so supported that the capillary-tube of the laboratory vessel standing on its shelf is on a level with that of the measurer. The stand which carries the trough is merely a prism of deal, 3 ins. in section, to the top and bottom of which are fastened pieces of board, 7×6 ins. On the right-hand side of the board serving for table, a slender rod is fastened, upon which slides stiffly, by means of a perforated cork, an elastic wooden clamp, which, grasping the neck of the laboratory jar, supports it firmly, whilst allowing of the needful motion. The flexibility of the connectors allows of the depression of the jar to the bottom of the trough, when necessary. The laboratory vessel is filled by suction in the usual way, and the clamp then closed, leaving a drop or two of mercury in the free part of the connector. The measuring-tube is filled by pouring mercury into the pressure-tube through a small glass funnel with a contracted aperture. Care must be taken to remove every bubble of air from the two-limbed tube, which may be easily effected by strongly tapping the stand after some mercury has been poured in. When mercury runs from the capillary tube, the clamp is put on, and the end of the tube is thrust into the connector of the jar, and fastened with twine. The gas for analysis is now introduced into the laboratory vessel, mercury is allowed to flow out of the tubes, the clamps are opened, and the gas passes over into the measurer. When the mercury has reached a mark on the horizontal part of the tube of the jar, the clamps are closed, the flow of mercury stopped, and enough of the latter poured in to equalise the pressure. All is now allowed to acquire the temperature of the air, which, as the apparatus has been but little handled, takes but a few minutes, and the level of the mercury then quickly re-adjusted and read off, noticing the temperature by a thermometer hanging from the tube of the measurer. The rest of the process differs so little from that of Regnault, to be found in many manuals, that it is unnecessary to further describe it; it must, however, be recollected that the gas must always be measured under the pressure of the atmosphere. In exploding gases in the measurer, the elasticity of caoutchouc so reduces the violence of the shock that there need be no fear of fracture or derangement of the apparatus. When, however, great contraction is likely to occur, which might draw over the whole of the mercury, followed by air, into the measurer, it is desirable to compress the connector at the bottom of the latter with the clamp or the fingers, so as to get time to pour in the mercury. After explosion, half-an-hour at least should be allowed for cooling. At the time of explosion, as well as during the time of cooling, the capillary-tubes should, of course, be full of mercury. Much would be gained in time, as well as in calculation, and something perhaps in correctness, by enclosing the tubes in a cylinder of water, as in Regnault's apparatus, but this would be at a sacrifice of portability, which is one of its chief merits. Having a convenient underground room of pretty constant temperature, I have as yet not been tempted to try this modification. Experiment has shown that, with proper care, there is no appreciable loss by diffusion through the india-rubber. Hydrogen, after standing for one and two hours, gave almost exactly the calculated contraction when exploded with oxygen. Carbonic acid did not alter in volume in three hours, but when both clamps were open, so as to expose a far greater surface of caoutchouc to the jar, it lost 0·2 c.c. in thirty minutes. Such a case would never occur in the course of an analysis.

As a measure of the capabilities of the apparatus, I give the proportions of oxygen obtained in thirty analyses of air collected under different atmospheric conditions, and from different spots in this town and neighbourhood, and previously deprived of CO_2, made during the last three months. The highest is 21·09; the lowest is 20·82; the mean is 20·95. The higher numbers are mostly after heavy rains, during high winds, or from air collected on heights at some distance from habitations. They agree with those of Angus Smith ("Air and Rain") in showing that the proportion of oxygen in pure air slightly exceeds that commonly given in books. The eudiometer used was somewhat smaller than that previously described, and was not intended for so delicate an investigation; of course, the CO_2 cannot be determined in such an instrument. The following analysis of coal-gas supplied to this town was made in May last:—

CO_2	=	0·10
O	=	0·29
CO	=	6·33
CH_4	=	42·16
C_nH_{2n}	=	6·23
H	=	43·25
N	=	1·64
		100·00

Doubtless, improvements may be made upon this eudiometer; hitherto it has answered all my requirements. Perhaps it might be made of larger size, and yet not be liable to leakage or fracture; the present size requires about 20 lbs. of mercury for eudiometer and trough. In the analysis of coal-gas, &c., where much is done by absorption, I use another similar apparatus without platinum wires, of the same height, but of somewhat greater capacity, for the earlier operations, completing the analysis in the exploding one, which is readily substituted for the former. This obviates the possible soiling of the exploding instrument by potash, &c., which is troublesome to remove during an analysis.

ON THE

ANTISEPTIC AND DISINFECTING POWER OF IODATE OF CALCIUM.

By E. SONSTADT.

IN the first of my papers "On the Presence of Iodate of Calcium in Sea-Water,"* I referred to the action of this salt on putrescible matter. Since that paper was published I have continued to make experiments on the properties of iodate of calcium as an antiseptic and disinfecting agent; the experiments have been made with the dry salt, and also with a solution of the salt made by dissolving 1 grm. of the iodate in 1 litre of water. The principal putrescible substances experimented upon have been urine, albumen, fish, meat, and rain-water.

The experiments on urine were begun in the spring of last year. Equal quantities of fresh urine were put into two test-tubes, and to one portion a small pinch of the solid iodate was added: the specimens were placed close together. After a few days the specimen to which nothing had been added became very offensive, and I added to it about a fourth of its volume of the solution containing 1 part of iodate to 1000 parts of water. The next day the offensive odour was gone, but still enough odour remained to make the nature of the fluid recognisable. The specimen to which the solid iodate had been added at no time took any offensive odour, and after several weeks could not even be recognised for what it was by the smell. The minute quantity of solid iodate that had been added to it remained apparently undissolved; up to the present time no sensible odour has been given off by this specimen. I have repeated this experiment several times with like result.

The experiment on albumen was begun on July 30, last year. Two fresh eggs were taken, and the whites put into two similar bottles. ½ decigrm. of iodate of calcium was added to, and shaken up with, the white in one of the bottles, the white in the other bottle being left as it came from the egg, for the sake of comparison. The two bottles were kept side by side, sometimes corked, sometimes uncorked, but were always treated exactly alike. The white of egg to which the iodate had been added remained sweet for about six months, after which it began to get discoloured and to smell disagreeably. It is now of a dirty yellow colour, and has a whitish deposit. The other specimen, containing no iodate, smelt disgustingly after about a fortnight, and is at present of a brown colour with brown deposit. The odour is perhaps now equally strong from both specimens, but there is as great difference between the quality of the odours as in the appearance of the specimens.

The experiments on fish have been chiefly made on herrings. Freshly-caught herrings immersed in iodate water (containing 0·1 per cent of iodate) remain in hot weather perfectly good for about four days, after which they begin to slowly change. If dry iodate is sprinkled over the fish (1 or 2 decigrms. of iodate to a dozen fish) instead of immersing them in the solution, the result is the same, and in neither case is it possible to detect the slightest foreign flavour in the taste of the fish. It is remarkable that the solid, and very sparingly soluble, iodate of calcium, which, so sparsely sprinkled over the fish, can only be in contact with very small spots here and there, should still exercise its preservative power throughout as completely as when a solution is used; that such is the case has, however, been proved, not by one or two experiments, but by many, since both last season and this, I have very frequently eaten fish kept fresh for a few days after being caught, by the dry or wet method indifferently. Salt herrings, a staple article of food in the Isle of Man in the winter time, have more or less of a disagreeable rancid flavour, whether eaten with or without removal of the salt they have taken up. But if salt herrings are first soaked in water long enough to remove as much of the salt as is considered desirable, and then immersed in iodate water for twenty-four hours, they lose entirely this disagreeable flavour, and are completely restored to the condition as to flavour that they were in when freshly caught.

I have made several experiments on the preservation of meat by the iodate, and have obtained results similar to those described for fish. In the case of meat, the solution of the iodate cannot advantageously be used, since the juices are extracted, and the meat thereby injured. A very minute proportion of the solid iodate, sprinkled over meat, will keep it good for three or four days (in summer time) longer than it will otherwise keep, and, if the meat has acquired a taint before the application, the taint is completely removed; this applies to the cooked, as well as to raw, meat. In one case, I sprinkled over a small joint of beef, which, after cooking, proved to be tainted to the bone and in every part, about a decigrm. of the iodate. The iodate was simply dropped from between the finger and thumb over—and, of course, only very partially over—the surface of the meat; yet the next day the meat was as good as it was possible for meat to be, and was eaten with much relish. How the nearly insoluble iodate can have produced such an effect over parts that it could not come near to, I do not understand; I only vouch for the fact.

Putrid rain-water becomes odourless and agreeable to drink twenty-four hours after the addition to it of one-fourth its volume of the 0·1 per cent iodate water. A litre of unfiltered rain-water to which 1 centigrm. of the iodate (1-100,000th) was added on the 10th of January, and kept in a bottle, is still, to all the senses, as it was on the day the specimen was taken.

Eggs, immersed in the iodate of calcium solution, were after a month not to be distinguished by smell or taste from perfectly fresh eggs; how much longer than a month they may be thus preserved, experience only can determine.

Fresh butter, covered with the iodate solution, loses nothing in quality during three weeks, and would probably have kept good much longer. Butter that has begun to get rancid is greatly improved by soaking for a day or two in the solution, especially if once or twice worked up in it. Salt butter, after the salt has been washed out, and steeped in the solution for a day or two, is, if originally of good quality, made nearly equal to fresh.

Such small quantities of iodate of calcium as may be introduced into food by the treatment described, do not in any way alter the normal taste of the food; the only modification produced is to restore the original flavour when that has been disguised or impaired by commencing decompositions.

In order to ascertain if much larger doses than any that could under any circumstances be introduced into the food eaten at a meal, could produce any injurious effect, I took at various times different doses of the iodate, the largest dose taken being 1 grm. This dose left a slight after-taste in the mouth, but I perceived no inconvenience, except a slight head-ache next day, an increased appetite, and, generally, such effects as might follow taking an ordinary dose of quinine. Some of my friends have tried small doses, such as a decigrm. at a time, in some cases with no sensible effect, in others with marked increase of appetite and

* CHEMICAL NEWS, vol. xxv., p. 197.

increase of vigour. But it is cases of fever and of attack by diseases such as typhus and cholera, propagated by some specific organic poison, that I should expect the exhibition of iodate of calcium to be followed by marked effects. A layman has small opportunity of making experiments in such directions. On one occasion, however, after exposure for some time to foul putrid odours, I found myself attacked by the usual premonitory symptoms of a typhoid fever, and all these symptoms *entirely* disappeared within a few hours after taking about a decigrm. of the iodate: one of my friends can give similar testimony. It appears to me that the iodate acts simply as a tonic on persons in health, but that, when there is an organic virus in the system, it is a potent agent in destroying such virus and in purifying the system. As a minor application, I may mention that the iodate has given speedy relief in cases of tooth-ache arising from caries.

I have made some experiments on the iodates of sodium, potassium, and of magnesium, in reference to any power they might have as antiseptics or disinfectants, but find them, although not quite without effect, very feeble as compared with iodate of calcium.

ON HEAT.*

By FREDERICK GUTHRIE, B.A., F.R.S., &c.

THIS Lecture was mainly devoted to "Temperature and its Measurement."

The lecturer began by showing that ice is lighter than water—an experiment performed by Nature in the floating of ice on water; further, that water as it freezes swells, and in passing from the liquid to the solid state exerts an enormous pressure. Several vessels are perfectly filled with boiled water, so as to deprive them of air, and screwed up. They are surrounded with a freezing mixture, which converts the water into ice, in which condition it occupies a larger volume, is lighter, and exerts an enormous pressure or bursting force.

In the case of gases, it was shown that they do not exhibit the same difference of expansion as liquids and solids, while all expand when heated equally. To prove this, two equal flasks, containing ordinary air and coal-gas respectively, are equally heated by being placed to the same depth in a trough where hot water is poured in, and there is a certain expansion,—bulk for bulk of each being driven out.

Exactly performed, these experiments give these results:—A cubic foot of hydrogen, or any gas, allowed to expand freely under ordinary atmospheric pressure, from the freezing to the boiling-point of water, becomes one cubic foot and three-tenths and six-hundredths (1·36). It is only with gases more easily condensible by cold than pressure that there is a noteworthy variation from this law.

The nearly equal expansion of glass and platinum enables the one to be fused into the other without any risk of fracture by contraction on cooling. Copper and iron might stick together as long as they were hot, but on cooling both would shrink differently, and separate. This equality of expansion of glass and Pt is used by the chemist to enable him to send an electric spark through gas for analysis, while the inequality of expansion is made use of in the construction of pendulums.

Of course the swing of a pendulum is slower the longer it is, and, since every material of which a pendulum can be formed expands by heat, in hot weather it goes slower, because the pendulum is longer. But by means of two metals, and limiting the size of the one, we can regulate and exactly counterbalance the expansion of the greater length of the other, thus keeping the centre of oscillation constant in position.

The mercurial pendulum is another form. There is a glass vessel containing mercury attached to the rod, and as the rod increases in length the mercury rises and the centre of oscillation is kept at rest, the pendulum having always the same rate of swing. By the superior expansion of alcohol over mercury, atmospheric temperature may be measured. A little diving-bell of platinum, fastened to a platinum wire, and containing alcohol, is plunged into mercury. When the temperature increases the mercury gets lighter and expands, but so does the alcohol,—the alcohol faster, however, and consequently some of the mercury will be driven out of the diving-bell, and there will be an upward pressure. By making the wire very thin an instrument of extreme delicacy can be made; besides, unlike liquid thermometers, it has the index free, and can register freely in the air.

Next, with regard to the force of expansion, and first of all with a solid. An iron pin is snapped by the contraction or cooling of an iron rod fastened to its centre. We may call this force infinite, considering through what a little degree it moves, and remembering the law of Mechanics—that the less the distance of any motion the greater the force. We are not dealing with a mechanical force, but with a physical force, and the same law holds true, for it exerts that enormous pressure in that expansion and in assuming its original molecular state.

An iron bottle is burst when water freezes in it, because, on freezing, the water swells. Most liquids, however, do not swell, but shrink on freezing, as is shown by the cavity formed in them when they solidify. Numerous and exceedingly curious examples of this molecular strain present themselves, and we may have this force locked up in the molecules for an indefinite length of time. Hot molten glass dropped into water solidifies; the outer crust is cold at first; then the inner molecules get cool, and endeavour to contract, either by leaving a vacuum between themselves and the already congealed solid glass, or by establishing a constant internal strain. There is really no more reason why such a vacuum should be formed in one place rather than the other, and the result is, though difficult to prove, that there is this internal strain, which can be distinguished by disturbing any one part where there is unstable equilibrium. Break off a point, and the whole is converted into powder, showing that the strain has been minutely distributed through the whole mass. Annealing glass is the regulation of the cooling of a semi-solid mass, so that the parts may shrink uniformly.

Liquids, when they expand, also exert an enormous pressure, but not so great as solids, as seen in the bursting of a flask full of water when the water is heated. Take a vessel of water mixed with ice, and heat it, and there will be no such reversal as the glass expanding and the water sinking, as is the case with simple water on heating at first, but the effect of the glass will be in the same direction as the effect of the melting of the ice. When the ice melts it gets denser, the water being more dense than the ice from which it is formed, and this continuous shrinking of the mass while heating proves clearly that, bulk for bulk, ice is lighter than water. Now, amongst all bodies in the liquid and solid form, water stands not exactly alone, but among a select number.

Let us now turn to the means which have been employed for the measurement of temperature, briefly describing the construction of thermometers. A good flask, with a well-fitting cork and a narrow tube, are the elements of a thermometer. But we wish to prevent the evaporation of the liquid, and to get rid of the pressure of the air, and to make the liquid adhere to the sides of the tube. It will be advantageous to take a liquid free from air, and shut the vessel off from the influence of the atmosphere in every way; then it is clear that if we are dealing with a ratio or fraction, and we want to measure the amount water or mercury increased when heated through a certain range of temperature, it is advantageous to take a great discrepancy between the capacity of the bulb and the tube or stem. Practically, it is found best to use a bore tube almost infinitesimally small, for the

* Abstract of the second of a course of Lectures to Working Men, delivered in the South Kensington Museum on Monday, the 24th ult.

smaller the amount of liquid the more readily it assumes the temperature to which it is exposed. One takes a tube far narrower than a hair, and the bulb may be filled with either alcohol or mercury; alcohol, if we are dealing with low temperatures, because alcohol has never been frozen; mercury, if we are dealing with high temperatures, because it requires a high temperature to boil mercury, although it can be frozen.

An ounce of mercury immersed in freezing water always has a certain size, and in boiling water it always has another and greater size, while at any intermediate temperature, got by mixing together freezing and boiling water in different proportions, it has an intermediate size. Accordingly, by measuring the size of any constant weight of mercury, we can tell what its temperature is. Plunge the bulb containing the mercury into freezing water, and the mercury shrinks in the stem to a certain point; plunge it again into boiling water, and it rises to a higher mark. The lower mark is sometimes called 0, and the other 100° (Centigrade) or 80° (Réaumur), or the lower is called 32° and the higher 212° (Fahrenheit).

Let us, in conclusion, notice the important fact that water is at its greatest density at 4° C.; at 3° it stands as high as it did at 5°; and at 2° it stands as high as it did at 6°. A frozen pond bears witness to the fact, for the water at the surface is at zero, while the water at the bottom is at 4° C., *i.e.*, the coldest water rises to the surface, and gravity induces the water at its maximum density (4° C.) to go to the bottom.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 4, 1873.

Dr. Frankland, F.R.S., Vice-President, in the Chair.

The minutes of the previous meeting were read and confirmed, and Mr. F. Brown was formally admitted a Fellow of the Society, after which the Secretary announced the donations which had been made to the library. The names read for the first time were those of Messrs. Frederick E. Harman, William Herbert Pike, Robert Francis Smith, Henry Bowman, Joseph Reddross, R. L. Taylor, William Joseph Spratling, J. Lawrence Smith, and Owen Davies Owen. For the third time—Dr. B. W. Richardson, F.R.S., Dr. Donato Tommasi, Messrs. Charles L. Field, Walter T. Goolden, B.A., Edgar Beckit Truman, Thomas H. Davies, William Masters, Alexander Campbell Dixon, James Baynes, Thomas Jamieson, Robert Williamson, Charles James Hislop Warden, Francis Jones, Sidney Knowles Muspratt, Felix M. Rimmingtons, Edward Cleminshaw, Samuel Herbert Cox, and Arthur B. Kitchener, who were then balloted for and duly elected.

The first paper, entitled "*Mineralogical Notices*," by Professor Story-Maskelyne and Dr. Flight, was read by the former. A specimen which had been sold to the British Museum as aurichalcite, from the Lead Hills, was found, on microscopical examination, to belong to an ortho-symmetrical system, and to possess the same crystallographic form as caledonite. The analyses of the mineral and of an undoubted specimen of caledonite were made, and the results in both cases corresponded to the composition represented by—

$$5PbSO_4+3CuH_2O_2+2PbH_2O_2,$$

indicating a composition corresponding with 3 equivalents of linarite, 2 of lanarkite, and 2 of water. As Brooke states that the mineral contains 9·5 per cent of carbonic anhydride, a determination of the amount present in this specimen was made, and found to be only about 1·4 per cent. The authors think that, as the mineral occurs associated with cerusite, the carbonic anhydride was probably accidentally present in the form of lead carbonate. An analysis of a very pure specimen of lanarkite showed that it contains neither water nor carbonic acid, but consists of lead sulphate and lead oxide.

The Chairman, in thanking Professor Maskelyne and Dr. Flight for their interesting communication on this mineral, said he could not help noticing the remarkable coincidence between the number of molecules of metallic sulphate and those of metallic hydrate, there being five of each.

Professor Lawrence Smith, of the United States, said he had analysed many of the minerals from the mines of Pennsylvania, and he might here mention the ease with which citrate of ammonia dissolved lead sulphate. Anglesite, for instance, dissolved readily in a solution of ammonium citrate, and the lead could then be precipitated as carbonate, and the sulphuric acid subsequently determined.

Mr. Field remarked that a solution of hyposulphite of soda answered equally well for dissolving lead sulphate; lead carbonate, on the contrary, was very insoluble.

In reply to an observation of Mr. Spiller, that he had pointed out in 1857 that lead sulphate was particularly soluble in solutions of the citrates, Dr. Smith said that he had made assays of lead ores by that method as early as 1852.

Mr. John Williams then exhibited some fine specimens of phosphates, including the crystallised acid; the latter was prepared by the action of water on pure phosphorus trichloride, the solution being concentrated by evaporation in a platinum basin. On allowing it to stand for twelve or fourteen hours, it solidifies to a crystalline mass; the sodium salt was the only one exhibited which crystallises well. On adding the sodium salt to a solution of platinum, the platinum phosphite is precipitated; this dissolves in the liquid when it is heated, and separates in the crystalline state on cooling. The acid precipitates silver and gold in the metallic state, the latter being coherent and presenting the usual metallic appearance; with sodium phosphate, on the contrary, it is precipitated in a very finely-divided state, and has a purple colour. With silver nitrate, the sodium salt gives the bright yellow silver phosphite, which becomes brown when heated. The crystallised acid itself, when strongly heated in a test-tube, gives off spontaneously-inflammable phosphoretted hydrogen.

Dr. Frankland said the members were much indebted to Mr. Williams for showing them the specimens of the phosphites, which had not received that attention from chemists one might expect. It was a new fact that the acid yielded spontaneously-inflammable phosphoretted hydrygen, it being generally stated that the gas given off under those circumstances was not spontaneously inflammable.

Professor Church then made a communication "*On Autunite.*" The published analyses of this mineral usually assigned to it the formula—

$$2U_2O_3,CaO.P_2O_5+8H_2O.$$

Pisani, however, gives it $10H_2O$, which is probably correct. The theoretical composition is—U_2O_3, 60·18 per cent; CaO, 5·9; P_2O_5, 14·96; $10H_2O$, 18·98; whilst $8H_2O$ requires only 15·7 per cent. On making an analysis of a specimen of Cornish autunite in beautiful lemon-yellow needles, the speaker found—U_2O_3, 60·00 per cent; P_2O_5, 13·84; and H_2O, 18·65; which corresponds to the formula with $10H_2O$. In order to obtain additional evidence on this point, crystals of French autunite were carefully selected under the microscope, powdered and dried; over sulphuric acid they lost 8·24 per cent of their weight, and at 100° 6·94 more, in all 15·14. A loss of $8H_2O$ would require 15·18. At 180° they lost 3·09, and at low redness 1·03, making 4·12; a loss of $2H_2O$ would require 3·79. The speaker said he hoped shortly to be able to complete his results and lay them before the Society in detail.

Professor Maskelyne observed that there was great difficulty in determining in what state the water existed in a mineral, and when Professor Church gave his complete description of the mineral, he hoped he would state whether

the loss of water over sulphuric acid was accompanied by a breaking up of the crystal. In a very fine specimen of the mineral, which had been about forty years in the British Museum, he had noticed a peculiar abraded or worn appearance of the crystals near the summits, for which he had been quite unable to account.

Professor CHURCH replied that he had observed that the Cornish mineral became somewhat greenish when dried *in vacuo*, but the French, whilst it retained its colour, became opaque. In an account of the corresponding phosphate of uranium and copper, published some years ago, he had noticed that its green colour became changed to yellow on drying.

Professor LAWRENCE SMITH, whilst describing a burner employed by him for heating crucibles, alluded to his process, published some time ago, for separating the alkalies in siliceous minerals, depending on the manner in which lime decomposes the silicates. One part of the pulverised mineral is mixed with 1 part of ammonium chloride, and then 8 parts of calcium carbonate, precipitated by ammonium carbonate from a hot solution of calcium chloride, are added. The mixture is introduced into an elongated platinum crucible, and heated to redness by means of a modification of Bunsen's burner having a sort of mouth-piece adapted to the top of the tube, so as to cause the flame to spread out somewhat like that of a "fish-tail" burner. The fritted mass, after removal from the crucible, is treated with water and ammonium carbonate to precipitate the lime, and the alkalies determined in the usual way; the whole operation on a felspar occupying about two hours and a half.

During the course of the evening a gas-burner, by Mr. F. FLETCHER, of Warrington, was exhibited.

The CHAIRMAN finally adjourned the meeting until Thursday, December 18th, when the following papers will be read:—"Researches on the Action of the Copper-Zinc Couple on Organic Bodies" (No. IV., "On Allyl-Iodide"), by Dr. J. H. Gladstone, F.R.S., and Mr. Alfred Tribe; "On a New Compound of Nickel and Phosphorus," by Dr. R Schenck; "On the Preparation of Standard Trial Plates to be used in Verifying the Composition of the Coinage," by Mr. W. Chandler Roberts.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 4th, 1873.

R. ANGUS SMITH, Ph.D., F.R.S., &c., Vice-President, in the Chair.

Mr. Joseph R. Bridson, Mr. James Watkins, and the Rev. William Marshall, B.A., were elected Ordinary Members of the Society.

The CHAIRMAN said that the death of Dr. Calvert, one of the most distinguished members of the Society, called for more attention than he was able to give it, but this meeting of the Society could not be allowed to pass over without a few words regarding the loss which all chemists must feel. It will no doubt be the pleasant duty of some of his friends to prepare a more detailed account of his labours. Meantime he (the Chairman) would express the opinion of all who knew Dr. Calvert by saying that a more diligent student of chemistry has rarely, if ever, been found in any country. It has been remarked that Dr. Calvert's knowledge of the literature of science was something marvellous; this was doubtless owing to his devotion to the subject and his untiring activity and strength. The memoirs which he has written are too numerous to be characterised at present, and already several journals have given the heads of the most important. As a medium of communication between scientific men, manufacturing and professional, in France and England, he was no doubt the means of doing much good in both countries. In the former country he felt almost as much at home as in the latter, having lived there from the time he was fourteen years of age until he was twenty-eight, and having married a French lady. It was this intimate connection with France which gave him his French accent, which he could never entirely get rid of. He was, however, entirely English by birth. His habits contracted there may have led also to that excessive activity which seems to have told at last in a very unexpected manner upon his health, as he seemed powerful and of sound constitution. The fatigues he underwent during a visit to the Vienna Exhibition, and the climate there, must, however, be blamed, so far as we can hear, for the evils both direct and indirect which produced a fatal result. Dr. Calvert had, shortly before his death, completed a revised edition of his lectures on some departments of manufacturing chemistry. His practical experience, combined with his profound knowledge of the theory of the subject, must render such a work of great value, and keep his name for a long time fresh among chemists. His later investigations, especially those connected with germs or the beginnings of life, were of a purely scientific character. He may be said in every sense to have been a successful man until that illness which destroyed a life which promised to be very long. He had many friends, and amidst an excessive amount of work he was able to be obliging and kind to a large number. He was a Fellow of the Royal and Chemical Societies and of several foreign Academies, and in the scientific circles of London and Paris he was as well known as in his adopted city, Manchester, where many lament him as a man who knew little of him as a chemist.

"*On the Bursting of Trees and Objects Struck by Lightning*," by Professor OSBORNE REYNOLDS, M.A. The results of the experiments referred to in this paper were exhibited to the meeting. The suggestion thrown out by Mr. Baxendell at our last meeting—that the explosive effect of lightning is due to the conversion of moisture into steam—seemed to me to be so very probable that I was induced to try if I could not produce a similar effect experimentally.

(1). I first of all tried to burst a thin slip of wood by discharging a jar through it, taking care so to arrange the wood that the discharge should be of the nature of a spark, and not a continuous discharge. This was done by making the wood to form part of a discharging rod, with balls on the ends.

This experiment was successful in the first attempt, although the results were on a small scale. It should be mentioned that the wood had been damped with water. This experiment was repeated with larger pieces of wood with various results.

(2). It then occurred to me to try with a glass tube. This I did at first with a very small tube, passing wires from the ends of the tube until they were within $\frac{1}{4}$ inch of each other.

The small tubes burst both with and without water.

(3). I then used a larger tube (about $\frac{3}{16}$ inch bore), using it in a similar manner. The discharge without water produced no effect on this, even when repeated several times, but when the tube is full of water (with the ends open) the first discharge shattered that part of the tube opposite the gap in the wire. This tube was bent in the form of a syphon, and the water stood about 1 inch beyond the gap in the wire on each side of it.

(4). I then tried a stronger tube which I had been using for insulation. It had a bore of $\frac{1}{4}$ inch, and was $\frac{5}{8}$ inch in external diameter. It was capable of sustaining a pressure of probably 10,000, and certainly 5,000 lbs. on the square inch; that is to say, a pressure of from 2 to 5 tons per square inch. It was about 14 inches long, and bent in the form of a square-ended syphon. The gap in the wire was about $\frac{1}{4}$ inch, and the water extended about $1\frac{1}{2}$ inches on each side of the gap. The ends of the pipe were open, and the jar charged in the same manner as before with about 100 turns of a 12-inch plate machine. The surface of the jar is about half a square foot, and the discharge, when effected with the common rod, took place through about 2 inches of air.

This tube was shivered at the first discharge. That part opposite the gap and for some way beyond is completely broken up into fragments which present more the appearance of having been crushed by a hammer than of being the fragments of a pipe burst under pressure. Some of the fragments show that the interior of the pipe has been reduced to powder.

These fragments were scattered to some feet on all sides, but there was nothing like an explosion. I held the pipe in my hand at the time of the discharges, and the sensation was that of a dead blow. There was no noise beyond the ordinary crack of the discharge.

The manner in which this pipe was destroyed clearly showed that a larger one might have been broken. But as it was two o'clock and my fire was out, I did not continue the experiments.

It is not easy to conceive the precise way in which a pressure of probably more than 1000 atmospheres could be produced and transmitted in a pipe of water the ends of which were open. It might have been caused by the sudden formation of a very minute quantity of steam, or by the expansion of the water; but whichever way it was, its effect was due to its instantaneous character, otherwise there would have been an explosion.

When we consider the great strength of this pipe (which might have been used for a gun without bursting), and when we see that it was not only burst, but that the interior of the glass was actually crushed by the pressure, and all this by the discharge of one small jar, we must cease to wonder at the bursting power of a discharge from the clouds.

NOTICES OF BOOKS.

The City Record. Vol. I., No. 51. (Official Journal). New York.

This journal is an American "institution," which might with great advantage be imitated in England. It is a Quarterly Report of the "Health Department" of New York. The reader finds in it a list of the various sanitary officials; a record of their proceedings; notices of changes in laws relating to public health; remarks on inhabited cellars, on street cleaning, street pavements, street garbage, sewerage and drainage, wharves and piers, public markets, slaughtering, fat-melting, stable manure, and night scavengering; removal of night-soil from the city; removal of dead animals, offal, &c.; manufacture of gas; permits; disinfection and disinfectants; impending pestilence, with special notes on the prevention of cholera; city mortality; bureau of vital statistics; sanitary bureau; expenditure of the Health Department; and an official directory. This paper is commonly sold in New York, and any person who wishes to satisfy himself as to the doings and the efficiency of the Health Department can purchase a copy. The nearest representative of this Record in London is the Report of the City Commissioners of Sewers. But this "Report," unlike its American contemporary, is not printed for general circulation; a few copies only are struck off for distribution to official personages. Editors of influential journals may succeed in procuring copies, but to the public they are practically inaccessible. Believing that, as far as sanitary matters are concerned, the Metropolitan Board of Works has not quite reached perfection, we should very much like to see a similar "Record" issued here. Perhaps, as a necessary preliminary, a new sanitary authority would be needed, consisting of men of a somewhat higher intellectual type than the nominees of the vestries.

Under the head "Disinfectants," we learn that the substances most in favour in New York are—Chlorides of zinc, iron, and of manganese; sulphate of zinc; carbolic and cresylic acids. The latter fluids are particularly recommended for the disinfection of drains, cesspools, privies, &c., on the approach of cholera.

CORRESPONDENCE.

INCOMPETENCE OR WORSE.

To the Editor of the Chemical News.

Sir,—In the interest of those of your readers who have a good deal of money staked on the honesty and accuracy of assays of raw material, I send you the following little statement of fact.

A firm of commercial analysts, acting for an importing house who recently delivered me a large consignment of phosphate, return as their assay of it "phosphoric acid 37·27 per cent, equal to tribasic phosphate of lime 82 per cent."

My chemist, finding their result a good deal higher than his own, was led to examine their certificate, and, immediately perceiving its inaccuracy, wrote to them asking for an explanation of their calculation. He received no reply to his letter, and the sellers coolly maintained that their chemist's result was correct, being calculated according to the universal usage of the trade!

In the face of my firm protest, they were instructed to assay a subsequent consignment, and their return of that was "phosphoric acid 38·11 per cent, equal to tribasic phosphate of lime 84 per cent." The sellers have since shown me a letter from them, in which they say that they "take 28 as the equivalent of lime, 70 as that of phosphoric acid, and 154 as that of the tribasic phosphate of lime" (!).

As, however, these "equivalents" only apply to their first assay, and their atomic weights for the second have not been communicated to me, perhaps some of your readers can help me out of my dilemma. Seriously, I am asked upon the first cargo to accept an assay return based on "equivalents" which make an amount in money over that of the real equivalents by some £13 to £14. For the second lot, a return is handed me which gives £14 to £15 over the true value, £11 to £12 of this being doubtless explained by the "equivalents," and £2 to £3 by a slovenly error in the calculation which would discredit any boy in our elementary schools.

I need not comment further on this *chef d'œuvre* of commercial assaying, when I say that the sellers have since withdrawn their invoice based on the "equivalents," and substituted another calculated properly from the phosphoric acid. I have, however, of course refused to recognise or respect the assays in any shape. To say nothing of the probability of the phosphoric acid itself having been calculated with home-made "equivalents," the way in which the decimals are burked is enough to take away one's breath. Even the first decimal is wrong; and every tyro amongst your readers will know that in the case of a cargo of phosphate at present prices the third decimal represents a considerable money value: what is said of the tricalcic phosphate applies, of course, with still more force to the more valuable phosphoric acid. I dwell on this because I have of late observed a tendency in other quarters to neglect that scrupulous care and exactitude which should characterise the work of every chemist. Certainly "work" such as I have here instanced cannot be too strongly reprehended. Manufacturers and consumers have surely sufficient cause of annoyance in the great discrepancies between honest analyses without the deliberate introduction of false equivalents. All, therefore, who are interested in the integrity and accuracy of assays and analyses, and in the maintenance of our English commercial morality and honour, should unite to put down this kind of thing with a firm hand.

I confess that, on public grounds, I have been very strongly tempted to publish the names of the offending parties. If, however, a milder course than an *exposé*, which would simply finish their reputation, will suffice to stimulate and maintain that strong public opinion which must alone make such practices impossible, I shall only be too glad, as I have no personal animus in the matter.

With regard to the other parties to the transaction—the commercial house (and one, too, whose name is very widely known)—I should have been disposed to attribute their action in the matter to sheer ignorance. That, however, cannot be fairly said of them. They would, at all events, very strongly resent the imputation. They are known as men who pride themselves very much upon their trade knowledge and experience, and are, in fact, continually laying down the commercial law upon any matter. I think, Sir, I must leave them to assess their own motives in this discreditable transaction.—I enclose my card, and am, &c.,

VERITAS.

HYDROGEN AND SOLUTION OF NITRATE OF SILVER.

To the Editor of the Chemical News.

SIR,—It would appear from a note by Mr. Wanklyn in the last number of your journal, that some remarks which I made at a recent meeting of the Chemical Society, *apropos* of Dr. Russell's paper "On the Action of Hydrogen on Silver Nitrate," have been erroneously reported. It is implied by Mr. Wanklyn's note that I asserted that the solubility of hydrogen in water diminishes with rise of temperature. What I did say was, although it is well known that hydrogen is equally soluble in warm and in cold water, it would be interesting to ascertain whether or not such uniformity prevails in its solubility in saline solutions, such as the silver nitrate.—I am, &c.,

A. W. WILLIAMSON.

University College, London, W.C.,
Dec. 8, 1873.

IRON FILINGS IN TEA.

To the Editor of the Chemical News.

SIR,—Permit me to add a few words to the observations of Mr. W. M. Williams, contained in your last number, upon the above subject. It is now more than two months since I discovered that the so-called iron filings tea contained no iron filings whatever, and from that time I have been attempting to inform the public of the fact. On October 22, I wrote a letter upon the subject to the *Morning Post*, but the editor of that paper did not think proper to publish my letter. Up to this time I had examined seven samples of the said tea, but all had been supplied by persons interested in the trade. It seemed to me then necessary, before making further efforts to publish my results, that I should examine an incontestably genuine sample of the tea, said to contain the filings. To procure this tea, I applied on November 1 to a gentleman who holds a high official position in the Corporation, but whose name I decline to publish. This gentleman most willingly undertook to serve me, though his efforts were unsuccessful until Nov. 17, when he forwarded me a genuine sample, duly marked "Tea adulterated with a large quantity of iron filings and sand." This tea, like all the other samples which I had examined, contained neither iron filings, iron turnings, nor metallic iron in any shape or form whatever. Like the rest, it contained magnetic iron ore and granitic quartz. On Nov. 19, I sent a letter stating this fact, and giving the exact composition of the tea, to the *Daily News*, but my letter was not published. On the 22nd, I sent a similar letter to the *Grocer*, with the same result. On the 24th, I sent a letter to the enterprising proprietor of the *Daily Chronicle*, and he published my account of the tea on Wednesday, Nov. 26.

With regard to the iron ore, there is a curious circumstance worthy of notice at present in it. The ore is not hæmatite, as Mr. Williams supposes, for it is attracted by the magnet. It is magnetic iron ore, and contains a large portion of phosphate of iron, so that it never could be converted into malleable iron, and consequently never has been, nor ever can be, in the state of iron filings. The granitic quartz is mixed with particles of felspar, mica, and a few fragments of hornblende; it no doubt constitutes the matrix of the iron ore, and thus comes to be associated with it on the tea, where, however, it is a manifest adulteration to the extent, I believe, of 25 per cent. And here let me offer a remark upon tea adulteration; I have found 6¼ per cent, 12½ per cent, and 25 per cent, in different samples of black and green tea, as if the Chinese adulterative mind worked by doubles, and not by decimals; thus, the above amounts of adulteration are ¼, ⅛, and 1-16. —I am, &c.,

LEWIS THOMPSON, M.R.C.S., &c.

IRON FILINGS IN TEA.

To the Editor of the Chemical News.

SIR,—In answer to Mr. W. M. Williams, I may remind him that I concluded that the magnetic particles were genuine iron filings from their solubility "in nitric acid with effervescence" (magnetic oxide being scarcely soluble in nitric acid). Certainly the reduction of copper is a more reliable test, but it did not occur to me to use it. By using the term "real *lumps* of metal," I did not intend to give the idea of great *size*, but merely to convey the impression that the particles were greatly larger than *filings* —probably as large as any of the type used for the title of Mr. Williams's letter.

As to your correspondent's question, "Were these found in the ash or in the unburnt tea?" I may express my astonishment that the published reports show that the chemists examined at the recent Birmingham trials looked for the iron filings in the *ash* of the tea. The method I have employed has been to powder the tea, and spread it out in a thin layer on a plate. A small electro-magnet has then been passed through it, and the attracted particles treated with hot water, which disintegrates the lumps, and allows the ferruginous matter to subside. The liquid being decanted, the deposit has been weighed, and further examined by the microscope, nitric acid, &c.

The tea in which I found the "lumps" of iron was examined some six months ago from curiosity. On my friend asking for some of the "rough flavoured, thick, sappy, Moning congou" described in the window-bill, the shopman added a portion of tea from a separate canister, and, on reaching home, this was readily picked out from the rest by its different appearance. It weighed about 5 per cent of the total quantity, and, besides the lumps of iron, contained sand, starch, magnesia, and plumbago. The percentage of tannin in it was 20 per cent, while even genuine black tea does not contain more than 14 or 15 per cent at the outside, a fact which I considered conclusive of the presence or catechu or other extraneous tannin matter. It will be evident, therefore, that the weight of metallic iron was not very large—probably 2 per cent of the whole tea; it was not actually estimated. The main bulk of the sample contained leaves other than tea, a considerable quantity of ferrous sulphate, and only about 5 per cent of tannin. I think these facts will be sufficient to convince Mr. Williams of the desirability of looking after the tea sold. As a matter of fact, the grocers are perfectly aware of the kinds of tea most frequently adulterated, and understand the use of a magnet and hot water as well as we do.

In his postscript, Mr. Williams calls attention to the summary of the magistrates on the Birmingham tea cases, and considers that the evidence is a strong confirmation of his theory of the origin of the iron detected in tea. At any rate, the magistrate thought differently, and, in the face of the fact that genuine teas contain neither magnetic matter nor insoluble silica, could not do otherwise than conclude that these substances had been purposely added to the teas found to contain them.

If Mr. Williams will look again at my letter, he will see that I suspect the English tea-dealers of the addition of

sulphate of iron, not metallic iron, though I remain unconvinced of the difficulty of obtaining the finely divided metal when wanted. At the same time, I fully admit that in the majority of cases the ferruginous matter consists of oxide or titanate of iron, and no doubt was added by the Chinese, probably in accordance with the instructions of the agents of the English merchants.—I am, &c.,

ALFRED H. ALLEN.

PS.—In my last letter, for the words "cayenne to give a sulphuric acid to vinegar," please read "cayenne to gin or sulphuric acid to vinegar."—A. H. A.

Sheffield, Dec. 6, 1873.

IRON FILINGS IN TEA.

To the Editor of the Chemical News.

SIR,—I thought that the "figment" of iron filings being in "tea" was finally set at rest by the decision of the "Stipendiary" in the late tea prosecutions at the Birmingham police-court, but, from what I see in your last two numbers, it is again beginning to be debated.

Having had the management of the chemical defence, it has occurred to me that it would be useful briefly to state the "reasoning," founded on experiment, why I came to the conclusion that not only were there no iron filings in the suspected tea, but that tea is never adulterated with iron filings,—that it is a libel on the Chinese to say that they ever put any in, and I am certain that none would be more astonished at the "charge" than the Chinese themselves.

The certificate given by the analyst of this borough stated that the tea was adulterated with "iron filings, sand, and earthy matter." As to the two last, the analyses of the tea, made by myself and colleagues (Dr. Wrightson, Prof. Murphy, Mr. Horner, and Mr. Scott), showed that this was so, and, finding that the tea stuck to the magnet, I thought, with the "analyst," that there were iron filings in it. But, considering that the Chinese have no vast fitting shops, as we have here, I wondered where they could get the iron filings from; I therefore thought it of great importance to get the iron filings out as iron filings, to do which I reduced the tea to powder, and then made it into a paste with strong alcohol; when this had been dried out, I searched the powder with a magnet, and attracted out some dark brown particles, which formed a "brush," just like iron filings would at the poles of the magnet. On examination, the particles turned out to be magnetic oxide of iron, but there where here and there little brilliant facets of something having a metallic look, which stuck to the magnet with the magnetic oxide, which seemed to me to indicate that the Chinese made a mixture of iron filings and magnetic oxide of iron to dose their tea with.

Up to this moment, therefore, I thought the borough analyst's certificate was correct; but, pondering on the matter, I put the brown magnetic oxides and sparkling particles on a sheet of paper, and, on viewing them with a "magnifier" in a good light, I thought I observed one shining particle which looked somewhat transparent. I then carefully separated it from the magnetic oxide, and, having detached every trace of the magnetic oxide from it, I found that the shining particle did not bounce to the magnet; it was, in fact, a small fragment of quartz, and some of the particles turned out to be mica.

In order to determine if there was any metallic iron at all, I treated the magnetic oxide with dilute hydrochloric acid, in which acid it dissolved without the least effervescence of hydrogen gas, which would have been the case if there had been a trace of metallic iron present, either rusted or bright. I also kept some of the magnetic oxide of iron in a solution of sulphate of copper for five days, without there being a trace of metallic copper precipitated.

Having thus clearly demonstrated that the magnetic oxide of iron is a natural mineral product, the idea occurred "If the Chinese put it into their tea, what do they put it in for?" for it is as much in green tea as it is in black tea. To answer this, I got out every trace of magnetic oxide from 100 grs. of the tea, and found that it only weighed 0·03 gr., a quantity so small as to be almost invisible, and yet so strongly magnetic was it that the most minute particle adhering to a large leaf (when curled) made it stick to the magnet. It was therefore absurd to suppose that so minute a quantity could be put in for any purpose whatever.

I now proceeded to examine a great number of "magnetic teas," and had London searched for the worst specimens which could be found, one of which was the tea "*ex Sarpedon*," which Dr. Letheby alluded to in his "Memorial to the Commissioners of Sewers" last April. Dr. Letheby will perhaps be surprised to hear that there is not a trace of iron filings in the "*Sarpedon*" tea; neither is there any in any of the magnetic teas which I have examined; but they one and all contain magnetic oxide of iron, and some of them contain oxide of manganese, doubtless derived from the soil of China. Unfortunately, we cannot examine the soil of China; I therefore examined the soil of many gardens in this neighbourhood, and found that, wherever there is black mould, magnetic oxide of iron is in it. If, therefore, leaves come in contact in any way with the soil, such leaves, when dried, will be attracted by the magnet. I recommend those interested in this matter to dry a few ounces of black mould in an oven, and then search it with the magnet, when the magnetic oxide will be readily attracted.

I have examined the dust of African ginger, Cochin China ginger, East India senna, American hops, chillies from Cayenne, and other vegetable substances from all parts of the world, and they all contain magnetic oxide of iron, but no iron filings.

I just add that the grocers are very sore at the charge about iron filings. They say, "Iron filings neither grow in the ground, nor are they in the juices of plants; if, therefore, iron filings are in tea, in however small a quantity, it must be a fraud, and ought to be punished." My advice, therefore, to the public analysts is to "change front" about iron filings, or they may "catch a Tartar," as was the case in the Birmingham police-court.—I am, &c.,

ALFRED BIRD, F.C.S.

Birmingham Dec. 1, 1873.

ALUM IN BREAD.

To the Editor of the Chemical News.

SIR,—In your last number, Professor Gardner, F.A.S., M.S.A. (and also, as appears from his advertisements, F.S.A., F.E.S., &c.), raises some objection to a late criticism in *Iron* on his aluminised bread analysis. The learned professor suggests that he could only have missed the alum if it had been ammonia-alum. Now, as there happens to be far more ammonia-alum in the market than potash-alum, it is, to say the least, singular that Mr. Gardner should prefer to employ a means which would only detect the kind he was least likely to find.

The principal point in question, however, is as to the volatilisation of sulphuric acid in preparing the ash. Anyone who takes the trouble to collate the published analyses of bread-, wheat-, and flour-ash, will see that the phosphoric acid therein is far more than sufficient to saturate the bases present. Under these circumstances, it is simply absurd to expect sulphuric acid, if present, to remain undecomposed in such an ash after ignition. Mr. Gardner, it seems, does expect a sulphate to be stable under these conditions. It appears, then, that he has made either an important discovery or a serious mistake. I, with many others, adopt the latter conclusion; and the Polytechnic professor would have shown himself wiser and more manly by confessing his error.—I am, &c.,

THE EDITOR OF "IRON."

Dec. 9, 1873.

CONCERNING ATOMS.

To the Editor of the Chemical News.

SIR,—Your correspondent "Atom" (CHEMICAL NEWS, vol. xxviii., p. 281) has stated that the existing difference of opinion amongst chemists, on the subject of Atoms, appears to arise from our incapacity to understand the meaning of "the infinitely small."

Now, with respect to space, I think a clear *positive* idea of the infinitely small is to be found in the mathematical definition of *a point* (having neither length, breadth, nor thickness). It exists in space (we may term it a *locus* in space), but has no extension, so that the addition of points (even *ad infinitum*) can never produce any finite space, however small.

I think the most determined opponent of the atomic theory will hesitate, however, before he attempts to apply the same argument to *matter;* and, if it be not applicable (that is to say, if matter must have *extension*), it appears clear that "matter cannot be divisible *ad infinitum*," which demonstrates the truth of the atomic theory, although it does not, of course, prove that in any case we have actually arrived at the ultimate division, even in theory.

With respect to "the infinitely great" it is utterly impossible to attain any *positive idea;* our nearest approximation is by a mental process of "increasing the finite without end,"—a pure negative notion; but in regard to two points we can be perfectly certain, viz. (1), that additions of the infinitely small can never produce anything finite; and (2), that additions of the finite (however large), even *ad infinitum*, cannot produce the infinitely great.

In fact, "the infinite" can never be either a multiple or sub-multiple of the finite.—I am, &c.,

HENRY HUDSON, M.D.

Glenville.

THE CHEMICAL SOCIETY'S NEW ROOMS.

To the Editor of the Chemical News.

SIR,—I am sure that such of your readers as are accustomed to attend the meetings of the Chemical Society will join with me in protesting against the bad lighting and ventilation of their new rooms.

The height to which the seats are raised, in so comparatively low a room, exposes their unfortunate occupants to a blinding glare and overpowering heat from the sunlights overhead; and this, added to the bad state of the ventilation, renders the room dangerously unhealthy; indeed, speaking of one or two friends, I can testify to its evil effects.

The room ought to be lighted by brackets, at least at the upper end, and better ventilation provided. At all events something must be done.—I am, &c.,

VENTILATOR.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, November 3, 1873.

Certain Calorimetric Values and Problems.—M. Berthelot.—The author announces the agreement of the results obtained by MM. Favre and Valson with his own. The only discrepancy, the case of borax dissolved in sulphate of ammonia, he explains by means of a double decomposition which takes place. Supersaturation he views as the slow formation of a new hydrate. Perhaps the existence and the disappearance of a great number of saline supersaturations express merely the existence and transit from one definite stage of hydration or of combination to another representing a lower degree of solubility.

Researches on the Thermic Effects accompanying the Compression of Liquids.—P. A. Favre and Laurent.—A mere preliminary notice "to take date."

New Volatile Saccharine Matter Extracted from the Caoutchouc of Madagascar.—Aimé Girard.—The author recently (*Comptes Rendus*, lxvii., p. 820, and lxxiii., p. 426) described two new volatile and saccharine matters, dambonite, $C_8H_8O_6$, extracted from the caoutchouc of the Gaboon; and bornesite, $C_{14}H_{14}O_{12}$, obtained from the caoutchouc of Borneo. Both these, on treatment with hydracids, are split up into methylic ethers on the one hand, and into crystalline non-volatile saccharine matters on the other, possessing the composition of dried glucose. A third substance of this kind, matezite, obtained from the caoutchouc of Madagascar, is white, crystalline, very soluble in water, less so in alcohol, from which it separates in the form of mamillary crystals, hard and gritty under the teeth. It fuses at 181° C. to a vitreous mass. At 200° to 210° it sublimes slowly without decomposing; the sublimate does not take the form of needles, but that of transparent drops. It consists of—

Carbon	42·3
Hydrogen	7·0
Oxygen	50·7
	100·0

Its formula is $C_{20}H_{20}O_{18}$.

Preparation of Active Amylic Alcohol.—J. A. Le Bel.—There appears to exist an inactive amylic alcohol boiling at 29° C., the constitution of which is well known, and an active alcohol, having a rotatory power of about 20° for a column of 50 centimetres. The latter alcohol has been less studied on account of the difficulty of its preparation. It boils, according to Pasteur, at 27° to 28°. It is deprived of its rotatory power by repeated distillation with potash.

Influence of Certain Gases on the Preservation of Eggs.—F. Crace-Calvert.—Oxygen in a dry state has no perceptible action. If the gas is moist the egg becomes covered in three weeks or a month with a white mouldiness, consisting of *Penicillium glaucum*, or of a *Mycelium*. On breaking the egg its contents do not appear to have undergone any decomposition; though an examination of the gases in the apparatus reveals the presence of a notable quantity of carbonic acid and of a little nitrogen. If the shell is perforated with a fine needle the egg is decomposed in dry oxygen, liberating a larger quantity of nitrogen and carbonic acid. There is a little *Mycelium* on the outside of the shell, and the contents, which are putrid, contain abundance of vibriones and mycrozymas. In moist oxygen the decomposition is more complete. In moist nitrogen, eggs, whether perforated or intact, may be kept for three months. If perforated, the contents are slightly decomposed; no filament of *Penicillium* can se seen, but vibriones are formed. In hydrogen the eggs are covered with a slight down, but the interior remains sound. In carbonic acid the eggs are preserved perfectly, and the shells do not show any trace of *Penicillium*. In coal-gas the results are similar.

Influence of Certain Substances upon the Preservation of Eggs.—F. Crace-Calvert.—The author plunged new-laid eggs in weak solutions, $\frac{1}{3\,0\,0}$ of chlorine, hypochlorite of lime, sulphite of lime, and phenic acid. Eggs in a solution of chlorine, in a stoppered bottle, remained unchanged from April 18th to December 12th

On being withdrawn from the solution and re-inserted, the bottle being left unstoppered, they were found on the 19th of December covered with *Penicillium glaucum*. In chloride of lime the eggs were found covered with *Penicillium* on April 28th, which continued to increase. On June 8th, it could be seen through the shell that the yolk was displaced, and numerous filaments of *Penicillium* appeared in the interior. In lime-water the eggs became covered with *Penicillium* in twenty days, and on June 8th, other forms of mould appeared in the interior. The contents were decomposed, the white containing much *Penicillium*, and the yolk abundance of microzymas. Sulphite of lime gave the same results. The eggs plunged in phenic acid presented no change up to June 8th. They were then slightly covered with mould, but the contents were quite sound.

On Malaria.—M. L. Colin.—The author concludes that the soil plays an important part in the generation of malaria; that the ingestion of marsh-water does not produce intermittent fever; that it will be easier to discover the febrigenous germs on the surface of land newly turned up than in the atmosphere of the marshes.

Analysis and Criticism of an Essay on the Constitution and Origin of the Solar System, by M. Roche.—Note by M. Faye.—M. Roche, supplementing La Place's theory, has studied the surfaces of level beyond the actual limits of atmospheres. He shows that, commencing from a certain distance, these surfaces cease to be convex towards the centre of the star. They merge into one another, and present infinite sheets, so that extending (in thought) the actual atmosphere of one of our planets to those regions of instability, the materials are no longer held by gravity to the star, but are dispersed in space along those surfaces. M. Roche deals with some difficulties attaching to La Place's theory. Saturn's rings, *e.g.*, are half contained within the actual limit of the planet's atmosphere, that is, in a region where it would be impossible (La Place's notions being rigorously accepted) that this atmosphere, in contraction, would have left these matters; whereas if it dilated, it might exist up to the half of their breadth. Other difficulties are the great distance of the moon from the earth, the gap between Jupiter and Mars, the multitude of asteroids (135 now known) in place of a single planet; then (coming sunwards), the formations so different from those beyond,—very dense planets with slow rotation,—M. Roche has treated such problems with the aid of a new conception. La Place, *e.g.*, only supposed rings frequent beyond the limit where gravitation towards the sun equilibrated centrifugal force. M. Roche shows, by the discussion of his surfaces of level, that the portion of the nebulous matter liberated does not merely come from the equator, but from a superficial sheet which extends much further towards the two poles, and which tends to flow towards the equatorial opening. Now, certain parts arrive with a velocity insufficient for their circulating exteriorly; they then return to nebulosity, describing ellipses, the aphelia of which are precisely at the equatorial limit. This being premised, M. Roche points out that, through the resistance of the medium, a portion of those materials ultimately falls to the sun, restoring to it some heat, while others merely lose, by their mutual reactions, their radial velocities, but retaining for the most part their tangential velocities. This idea of interior rings rendered free, in their turn, by the progressive contraction of the generating atmosphere, supplies M. Roche with the explanation of a part of Saturn's rings forming where, according to another law, no satellite of the same density as the planet could form. M. Roche's original ideas are these: Equality of duration, at first, in the rotation and the revolution of each planetary mass; impossibility of formation of satellites so long as the solar action could maintain this equality; possibility of such formation whenever the contraction of the limiting surface of the atmosphere has reduced the directive force of the central star; formation of interior rings at the limiting surface; condition in which a planet, or a fluid mass, may conserve its figure of equilibrium, spite of the formation of the central body. (The distance should not be below five-fourths of the quotient of the diameter of the latter divided by the cubic root of the density of the satellite). M. Faye warmly commends M. Roche's work.

Mutual Action of Voltaic Currents.—M. Bertrand.—In 1871, M. Helmholtz proposed a new formula to replace Ampère's law on the elementary action of circuits. M. Bertrand considered the new law did not correspond to any force of determinate strength and direction operating between two elements, and that it must be rejected. M. Helmholtz recognised that no force, according to his law, would represent the action of an infinitely small element on an infinitely small element; but he does not see here a decisive argument against his theory. The action of two elements is composed of a force and a couple acting on each of them, and this, in his opinion, does not involve contradiction. But (urges M. Bertrand), following out such principles to their conclusion, and calculating the moment of the couple, one finds that the force producing it must have a finite intensity. Whatever the tenacity of a wire, an infinity of forces of finite strength distributed throughout its length must produce rupture. M. Bertrand here reproduces a memoir, in which M. Helmholtz has lately, in the Berlin Academy, returned to the question; and proposes shortly to reply to it.

Verification of the Areometer of Baumé.—MM. Berthelot, Coulier, and D'Almeida.—The authors give some numerical data towards establishing the graduation of the instrument. The saline solution serving as type in the areometers was prepared by dissolving 15 parts of pure chloride of sodium in 85 parts distilled water weighed in air with brass weights (the pressure being 0·760 m. and the temperature 12·5°), 1 litre = 1110·57 gr. Next, as to the production of 1 litre vessels at a temperature of 12·5°, the authors show that the 1 litre vessels constructed at 15°, under the supposition that each contains 1000 grammes of water, weighed in air, are too large by about two-thousandths.

Observations of Solar Protuberances (continued) During the Last Six Rotations of the Sun, from 23rd April to 2nd October, 1873; Consequences as to the Theory of Spots.—P. Secchi.—This series shows a considerable decrease in the number of eruptions. While in the first series of 1871 the number was, on an average, 14 or 15 daily, with maxima of 20 to 23, and minima which rarely descended to 10, the last rotations give an average of 8 or 9, and the maxima do not exceed 12, while the minima are 4 or 5. The spots are also less numerous. From the longitudinal distribution of protuberances, it appears that some meridians gives distinct minima and others maxima. Opposite points on the east and west borders often show agreement, a diametrical distribution apparently; but these details disappear in the averages. The metallic eruptions have been few and very intermittent; one, on the 18th Sept., was very memorable, and produced a group of spots. The author finds confirmation of his theory of spots. To the statement that there appear eruptions without spots he replies—(1) That these cases are very rare; (2) that the eruptions are weak, and the (comparatively) small masses projected are immediately dispersed; (3) he has noticed that certain metals have a greater efficacy (in production of spots) than others. Thus the eruptions charged with sodium give very pronounced spots; magnesium is less efficacious, and there are often beautiful eruptions of this metal without very dark spots. The cases of spots without eruptions have not been rare, but there have been few of them on the east side. Father Secchi remarks on the sheaf form of some of the protuberances, and gives a sketch. As to the direction of protuberances, he always found, in the high latitudes, the dominant direction is towards the

poles; in low, towards the equator; the change of direction occurring at about 40°. In calm periods there is a somewhat different system of directions from what is found in periods of activity.

Report on a Memoir of M. Graeff on the Application of the Curves of Discharge to the Study of the Régime of Rivers, and to Calculation of the Effects Produced by a Multiple System of Reservoirs.—MM. Phillips.—M. Graeff shows that the effect of a single reservoir in a neighbouring region down the stream is certain, and may be exactly estimated; that the effect of several reservoirs on the same water course is also certain, though less easy to appreciate; and, lastly, that where there are at once reservoirs on the principal watercourse and on its affluents, the uncertainties increase so much that this system is not advisable, unless in quite special cases.

Influence of Atmospheric Refraction at the Instant of Contact in the Transit of Venus.—M. Oudemans.—The author shortly critises a note of M. Dubois, and thinks that, in any case, the influence of refraction must be less than 0·13 s.

Frigorific Effects Produced by Capillarity Combined with Evaporation; Evaporation of Sulphide of Carbon in Porous Paper.—M. Decharme.—Reserved for translation.

Remarks on Various Practical Problems of Aërial Navigation (Extract).—M. de Fonveille.—The author thinks it highly probable that the gas of a free balloon differs in temperature from the external air by 10° c., at least twice daily. This rupture of thermal equilibrium must limit its course to a very small number of days; independently of other disturbing causes, it would render a passage across the Atlantic impossible. Nor can the disturbance be obviated by closing the orifice of the balloon with a hermetic valve. A small balloon of transparent caoutchouc explodes loudly when merely pierced with a pin; this is due to the surprising rapidity with which the membrane is rent, although the pressure of the hydrogen does not greatly exceed that which would obtain within a large free balloon, where it might be sought to neutralise the effects of the solar dilatation. Nor would the greater resistance of envelope obviate the disaster. M. de Fonvielle also remarks on the despatching of pigeons from balloons at regular intervals, on the disastrous voyage of Mountain and Bailey, and other topics.

Note on the Best Dimensions to give to Electro-magnets.—M. du Moncel.—The writer constructs a formula from which flow some important conclusions; more especially (1) That for resistance of equal circuits, the diameters of an electro-magnet should be proportional to the electromotive forces; (2) for equal electromotive forces, the diameters should be in inverse proportion to the square root of the resistance of the exterior circuit, including the resistance of the battery.

On the Recent Eruption of Nisiros.—M. Gorceix.

Bulletin de la Societe Francaise de Photographie, No 10. 1873.

This number contains a continuation of M. A. De Constant's paper on the dry collodion process.

Modification of the Collodio-Bromide of Silver.—J. F. Plücker.—The author remarks that this process is the most simple known, and yields results as good as, if not better than, those of the iodide and the silver bath. It has, besides, the advantage of rapidity in the preparation of sensitive surfaces, and that of avoiding the use of a costly solution of nitrate of silver. The development of the image is very regular. The sensibility in respect to objects which reflect abundance of chemical rays is the same as that of surfaces of iodide and iodo-bromide of silver, but it is greater for feeble rays such as those issuing from verdure-shaded parts, &c.

Preparation of the Bromised Collodion.—Dissolve in 100 c.c. of alcohol 2 grammes of bromide of cadmium and 0·5 gramme bromide of ammonium; add to the mixture 2·5 grammes of papyroxyl (paper converted into nitro-cellulose) and 150 c.c. of sulphuric ether. Introduce into the solution 0·8 gramme of yellow gum-lac in scales, which is dissolved by the aid of the water-bath. Finally, 4 drops of pure nitric acid are added. After resting from two to three weeks, the collodion is ready for use. To render this collodion sensitive, an hour before the layer is required, the following solution of nitrate of silver is required. Put into a test-tube of about 12 centimetres long and 15 millimetres in diameter, 1 gramme of crystallised nitrate of silver in fine powder, and 4 c.c. of rectified alcohol, to which 1 drop of distilled water is added. The mixture is carefully heated till the nitrate is dissolved, and the solution is immediately poured into 50 c.c. of the above described collodion decanted previously into a small wide-mouthed flask. This operation is performed in the dark. It is well shaken for some seconds, let settle for an hour, and the emulsion decanted into a second bottle. The plates are covered with the collodion thus prepared, the excess being each time allowed to flow back into the bottle. The prepared plates are washed with rain-water, so that they may be quite free from undecomposed nitrate of silver, and are then set to dry, or before drying they may be coated over with some preservative, such as tannin, dextrin, acetate of morphia. The backs of the plates should be coated with some black or yellow colour. *Development.*—After having softened the sensitive layer by the aid of a mixture of equal parts of ether and alcohol, the quantity of water necessary to cover the plate is put in a developing glass, and a few drops are added of an alcoholic solution of pyrogallic acid containing 15 per cent, and a drop of an aqueous solution of carbonate of ammonia of 10 per cent.

Process for Preventing Solutions of Gum-Arabic from Moulding.—M. Hirshberg.—A little concentrated sulphuric acid is added, which precipitates the lime present. Solutions treated in this manner have been kept for eighteen months without losing their adhesiveness, or growing mouldy.

The bulk of the papers in this number are from English sources.

NOTES AND QUERIES.

Cigar Ash.—In the analyses of cigar ash by A. Percy Smith, F.C.S., in the CHEMICAL NEWS, vol. xxviii., p. 261, the component parts represent only 94·236, instead of 100·00 as stated.—W. SIMMONDS.

Insoluble Gelatin.—In the CHEMICAL NEWS, vol. xxviii., p. 109, there is a short paragraph on the power of bichromate of potash to make gum, gelatin, &c., insoluble. Can you inform me where I can ascertain particulars as to the mode of procedure, quantities to be used, &c.?—JAMES BARCLAY.

MEETINGS FOR THE WEEK.

MONDAY, Dec. 15.—Medical, 8.
TUESDAY, 16.—Civil Engineers, 8.
—— Anthropological 8.
WEDNESDAY, 17.—Society of Arts, 8.
—— London Institution, 7.
—— Geological, 8.
—— Meteorological, 7.
THURSDAY, 18.—Zoological, 4.
—— Royal, 8½.
—— Philosophical Club, 6.
—— Chemical, 8, W. C. Roberts, "On the Preparation of Standard Trial Plates to be used in Verifying the Composition of Coinage;" R. Schenck, "On a New Compound of Nickel and Phosphorus"; Dr. Gladstone and A. Tribe, "Researches on the Action of the Copper-Zinc Couple on Organic Bodies;" No. IV., "On Allyl Iodide."

ERRATUM, p. 282, line 25 from bottom, *for* C_2O_3 *read* CrO_3.

THE CHEMICAL NEWS.

VOL. XXVIII. No. 734.

ON A NEW METHOD FOR PRODUCING THE ANHYDROUS CHLORIDES OF ALUMINIUM AND OTHER METALS.

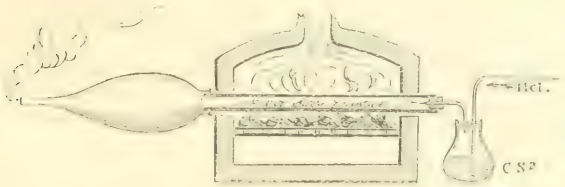
By PAUL CURIE.

THE only published process for the production of aluminium chloride is the well-known method of sending chlorine through a mixture of pure alumina and charcoal, heated to redness. The following is, I believe, a simpler method, which might perhaps, in many respects, prove economical for the manufacture of aluminium, as it does not require the use of pure alumina, nor the preliminary calcination of the same with charcoal. This process is based on the transformation of alumina into sulphide of aluminium, and subsequently of the sulphide into chloride, which two operations are condensed into one by the means hereafter described.

Sulphide of Aluminium.—This is obtained by heating alumina in a tube or retort, through which are sent vapours of bisulphide of carbon, the reaction which takes place being expressed thus :—

$$Al_2O_3 + 3CS_2 = Al_2S_3 + 3COS.$$

Sulphide of aluminium then remains in the tube or retort. The gases which escape are mostly COS, though a portion of that oxysulphide of carbon is decomposed on account of the too great heat; there is therefore, also, a certain quantity of sulphur and of CO.



Sulphide of aluminium is not easily converted into chloride, as might be thought, by double decomposition with the chlorides of other metals: thus, with NaCl only a very small quantity of chloride of aluminium is produced; with CaCl,MgCl, none at all; with KCl it forms a volatile compound, containing KCl,KS,Al_2S_3, and Al_2Cl_3; but by hydrochloric gas, HCl, the chloride of aluminium is readily produced.

To effect the conversion of alumina into chloride of aluminium, by a *single* operation, this is how I proceed:—The alumina is placed in a porcelain or earthen tube, and heated to redness. As soon as all the water is expelled from the alumina, the tube is connected at one end with a receiver, and at the other end with a tube, bringing in a mixture of hydrochloric gas and sulphide of carbon vapours. By merely sending the HCl gas through the liquid CS_2, it is so thoroughly saturated with it that it is not necessary to apply heat to the latter. A double reaction takes place simultaneously, and chloride of aluminium distils at once, mixed up with a certain quantity of sulphur and impregnated with HS. The aluminium chloride is afterwards re-distilled with iron filings, so as to free it from the sulphur and other impurities.

This process can be easily adapted to the production of all or any of the other metallic protochlorides. I have succeeded equally well in forming magnesium and chromium chlorides.

In order to make a pure aluminium chloride, as I have already stated, it is not necessary to use pure alumina. Ordinary clay will succeed just as well: in that case the chloride of silicium, which is formed at the same time, escapes as a gas, and the other chlorides formed,—such as those of iron, calcium, &c.,—being less volatile than that of aluminium, remain in the tube or retort.

ANALYSES OF TEAS.

By A. S. WILSON.

THE following analyses, made recently, may be useful for comparison. The first seven samples are shipments of last season's teas, and were received direct from the importers. The microscopic examination showed that they were all genuine, although the leaves presented very different appearances, those of the Pekoe being small and thin, whilst those of the Assam were large and thick. Sample No. 10 was ordinary black tea, as retailed, and consisted probably of Moning with a small admixture of Assam and Pekoe. No. 8 represents an Assam green tea, of very fine quality and quite free from facing. No. 9 is China green tea, "faced," but otherwise of fine quality. The facing consists of steatite, or some other magnesian silicate, and turmeric, with an exceedingly minute quantity of Prussian blue.

Several persons have been prosecuted, under the Adulteration Act, for selling faced tea: the result has been that green tea has deteriorated in value, if, indeed, it has not been completely driven from the market.

At a recent prosecution case, in Glasgow, the city analyst stated in his evidence that this tea (No. 9) contained 3 per cent of adventitious substances, but this could only have been intended as an approximation, since there is no means of estimating the quantity of turmeric. In giving evidence for the defence, Dr. Wallace stated that the quantity of Prussian blue did not exceed a tenth of a grain in an ounce of tea; and as green tea is only used for mixing with black, and seldom to the extent of more than 10 per cent, it follows that an individual is not likely to consume at one time—even supposing the whole of the pigment to become suspended in the infusion—more than the two-hundredth part of a grain of Prussian blue. It was further argued for the defence that, as the added ingredients are not poisonous, and are evidently not introduced for the purpose of adding weight (since the quantity would not pay the expense of the manipulation), the case was not an offence under the Adulteration Act. The vendor, however, was fined for selling it, and fines have been imposed on several others since then for the sale of tea of a similar kind.

In the following table A represents the percentage of ash; B, the proportion of the ash soluble in water; C, that soluble in hydrochloric acid; D, the siliceous matters; and E, the amount of peroxide of iron in the ash.

	A.	B.	C.	D.	E.
1. Moning	6·00	3·15	2·03	0·82	0·05
2. ,, ...	5·82	2·73	2·52	0·57	0·07
3. ,, ...	5·90	2·70	2·36	0·78	0·07
4. ,, ...	5·55	2·66	2·21	0·68	0·09
5. Kaisow	5·43	3·33	1·88	0·22	0·05
6. Foochow Pekoe.. ..	6·15	3·20	2·16	0·79	0·09
7. Assam Souchong ..	5·15	2·90	2·05	0·20	0·03
8. Green Assam	5·32	2·94	2·11	0·27	0·08
9. Fine Green tea, faced	7·14	2·38	3·19	1·57	0·12
10. Black tea, mixed ..	5·68	2·86	2·33	0·49	0·04

Perkin and Son.—We understand there has been recently a movement on foot for converting the concern of Perkin and Son, the great patentees and manufacturers of alizarin, at Sudbury, into a Limited Liability, with a paid-up capital of £200,000. We learn, however, that the entire business and patents have just been purchased for a very large sum by Brooke, Simpson, and Spiller, the well-known London manufacturers of aniline colours.

ON HEAT.*

By FREDERICK GUTHRIE, B.A., F.R.S., &c.

The points treated of in this Lecture were—"Conduction and Convection; Capacity for Heat; Heat Quantity; Specific Heat."

With regard to the passage of heat through space, it does so in three ways—by conduction, by convection, and by radiation. A candle and an ordinary pin may illustrate these. When the pin is held in the flame of the candle quite steadily, both are at rest, but the heat gradually creeps along the pin from end to end; that is the conduction of heat. When the candle is moved from one place to another, the heat travels with the hot body, just as in the flight of a red-hot cannon-ball; that is the convection of heat. When the hand is placed by the side of the candle, it gets hot, because the heat is radiated from the candle in all directions, striking surrounding bodies and heating them; that is radiant heat, and the most prominent example in Nature is the sun.

Examining different bodies as to their conduction of heat, we find that the metals exhibit an extraordinary pre-eminence in their power of conducting heat. As a class, solids conduct heat better than liquids, and liquids better than gases.

Amongst solids, the metals conduct heat best, as can be simply shown. A compound cylinder of brass and wood is wrapped round by a piece of paper, which is heated at the junction of the two solids. The paper is scorched on the side of the wood, but is unscorched on the side of the metal, because the brass conveys away the heat from the paper so quickly that the paper is kept comparatively cool. The sensation of heat very much depends on the nature of the substance with which the hand is in contact. Thus, a piece of brass and a piece of wood exposed to the heat of the sun for an equal time give nearly the same temperature with a thermometer; if anything, the wood is hottest: but test them by the hand, and the metal appears to be the hottest. Why? If the brass be hotter than my hand at the point of contact, there is an equalisation of temperature, the brass gives heat to the fingers, and that heat withdrawn is instantly replaced by heat from other points of the brass, so a constant supply is sent into the hand; whereas, the hand in contact with the equally hot wood withdraws heat, but that heat is not supplied from the neighbouring portions of the wood, and it is not poured into the hand. In the case of the metal, the hand really receives more heat in the same time.

There is one important practical application of the conduction of heat by metals to be noticed. Take a ring of copper, and pass it over a lighted match or wick of a candle, and, although it does not touch them, the flame goes out. For gas to burn in contact with the air, a certain heat is necessary for the combustion of the hydrocarbons; if, therefore, by contact with a metal, the temperature is reduced below that necessary for their union, the flame goes out. Here is a mixture of coal-gas and air burning in the ordinary way, and if we introduce between the source of heat and these mixed gases a metal wire gauze, then it happens that the gas burns above the gauze, but the flame does not strike through. The gases are too much cooled beneath, in contact with the gauze, for their combustion to be possible, neither can the flame strike back, for, in passing through the meshes of the gauze, the gases are too cool for combustion, the heat being radiated by the fine meshes into space. [The lecturer here took a piece of wire gauze, and bent it round in semi-cylindrical form, having the source of light in the inside, and the source of combustion, or the mixed gases, outside, the light inside the gauze not striking through. This semi-cylinder of gauze was next bent completely round, still enclosing the light, and the gases outside did not burn.] That is the principle of the Davy lamp.

Copper conducts heat better than iron, as seen in heating rods of the two at the plane of contact, and noting the melting of fragments of wax arranged along the two. That silver conducts heat better than platinum is indirectly proved by heating a compound wire of the two metals by an electric current; the silver remains dull and comparatively cold, while the platinum, no thicker than the silver, gets red-hot.

Between the conducting power of liquids and that of solids, there is such a wide gap that the two groups have not been linked together. In the first place, let us see that liquids are bad conductors. Take some ice in a test-tube, putting a little fragment of copper wire on the top to keep it down, then pour hot water above it, and the hot water can be actually boiled without melting the ice, showing that the water has not been able to carry down the heat. Yet water, of all liquids, excepting molten metals like mercury, stands at the head, having the greatest conductivity, or the least thermal resistance. The conducting power of liquids is measured by heating the upper surface of a film of liquid, and noting the expansion of air in a chamber upon whose upper side the liquid film rests. The more complex the composition of a liquid is, the more opposition does it present to the passage of heat by conduction, and liquids containing halogens also resist the passage of heat.

That gases have very small conducting power is familiar to all of us in everyday life. The imperfect conduction of many solids is due to the gases, generally air, which they enclose in their pores or between their fibres, and hence clothing protects the body from loss of heat in cold weather, and from the scorching heat of the sun in hot weather. The double windows used in cold countries, the fire to keep in the heat of the body in cold weather, and the turban used in hot countries for keeping out the heat of the sun, are all examples of the practical application of the bad conduction of gases. A red-hot ball may be carried in the hand if a mass of asbestos is interposed, because the air entangled in its pores refuses almost perfectly to conduct heat. Hydrogen conducts heat far better than other gases, and accordingly cools bodies in contact with it with greater rapidity, but some say this is due to the nimbleness of motion of its parts, and that the cooling effect is due to convection.

We come now to the mode in which heat travels by convection; and as solids, as long as they remain solids, cannot have any molecular motion of this kind, there are only two examples—the convection of liquids and gases.

A fluid is a fluid on account of the facility with which its parts move amongst one another. Since liquids expand when heated, it is clear that a mass of hot liquid in the bosom of a cold liquid of the same kind must tend to rise. Accordingly, we find if we heat a mass of liquid on one side, currents are established on the side which is heated. Perhaps the best illustration of this was given by taking the source of heat itself in the bosom of a liquid, and showing its effect on the screen by the lime-light. A spiral of platinum in water has a current of electricity passed through it, which heats the wire, and streams of water rise upward from the platinum. But Nature presents us with phenomena, based on this relation between hot water and cold, on a vaster scale. It is found that the ocean is traversed by enormous currents, tending in our hemisphere from the south to the north, and having an easterly direction. The great type of this current may be called the Gulf Stream, and it is as vain to talk about its beginning as that of an india-rubber band. There is circulation throughout, and the motion is carried on continuously. The causes of the Gulf Stream, as considered independent of its source, have been variously traced. It has been said that heat plays upon the Equator more than it does upon the Poles, and that is mathematically true, for at the Poles the heat strikes more obliquely. That is the prime reason why the Polar regions are colder than the Equatorial. Then it has been said that, this being

* Abstract of the third of a course of Lectures to Working Men, delivered in the South Kensington Museum on Monday, the 1st inst.

the case, the earth at the Equator, getting more heat than at the Poles, gives its heat more abundantly to the water, and swells the water, and that swollen water is carried to the Poles: there is something illogical in this, because the swollen water is not heavier than the unswollen water. Then the explanation has been given that it is owing to the prevailing winds at the Equator. But, speaking under correction, I imagine that the origin of the Gulf Stream is rather to be looked for at the Poles than at the Equator. When water freezes it gets lighter: a quantity of water freezing at the Poles has the result of a lifting of water above the water, and the leaving of a quantity of brine, the same temperature as the ice at the moment of freezing, but denser. The heavy brine therefore sinks, and travels from the Pole to the Equator beneath the general mass of the water, and this current has to be compensated for by the travelling of warm water at the surface from the Equator to the Poles, which finally encounters and melts the ice-floes moving in the opposite direction. Thus, modified by the winds, and guided by the contour of continents, it tempers our climates so materially and, for us, so essentially, having for a return current that current at the base of the ocean which we seldom can recognise but by the deepest plumbing.

With regard to the conduction of heat by gases the whole system of ventilation depends upon it, and also upon the elementary fact that all gases swell by heat, and therefore, if a hot mass of gas is imbedded in a cold mass of the same gas, it has a tendency to rise.

And now we come to a point which requires considerable power of abstract reasoning to see it clearly, and therefore the simplest illustrations possible will be used. Different substances have different capacities for heat, *i.e.*, if we take equal weights of two different substances at the same temperature, and put the same quantity of heat into each, we shall find them in most cases to be unequally heated; or, if we take the same quantity of heat out of each, the one which was before heated most is now cooled most. We may aptly compare the capacities of different bodies for heat with the capacities of different cylindrical vessels for water, comparing the temperature with the liquid levels. Thus, the level of the water in a wide cylinder will be less affected by the addition or withdrawal of a given quantity of water than the level in a narrow cylinder. Four metals —Fe, Cu, Zn, Bi—are all taken from the same oil-bath, and placed upon the same sheet of wax. The melting power of Bi will be represented by the cylinder having the less capacity for water.

There is, therefore, a most important difference to be observed between the quantity of heat in a body and the temperature of a body. The quantity of heat is measured by the heat-unit, which is generally considered as the quantity of heat which will raise 1 grm. of water at 0° C. to 1° C. It is found experimentally that if a hot body be able to heat 1000 grms. of water 1° C., it will heat 500 grms. 2° C., and so on, proving that the capacity for heat of water is nearly the same at all temperatures.

The ratio between the capacity for heat of one body and the capacity of an equal weight of another body is the specific heat of the first compared with the second. Water is the substance generally taken as having the standard or unit capacity for solids and liquids. Suppose, then, we plunge 1 lb. of a metal at 100° C. into 1 lb. of water at 0° C., and find that the resulting temperature is 12° C., we know that the 1 lb. of metal in falling 88° C. has raised the 1 lb. of water 12° C. The capacity of water is therefore greater than that of the metal, in the proportion of 88 to 12, or the specific heat of the metal is $\frac{12}{88}$, or about 0·14. It must be well borne in mind that specific heat is not heat at all, but number—number got by comparison or division, just like specific gravity. Further, that it is, like specific gravity, independent of the quantity or individuality of the matter under consideration. We are obliged to operate with a certain size and weight of any substance, say copper, but we obtain the specific heat of all pieces of copper—of copper in the abstract.

ON THE ENERGIES OF THE IMPONDERABLES,

WITH ESPECIAL REFERENCE TO THE

MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 287).

SIR H. DAVY, in an article "On the Causes of the Colours of Organic Beings," written about 1790, when Davy was only 19 years of age, writes—"Nature has catenated together organic beings, and made them mutually dependent on each other for their existence, and all dependent on light. A privation of light would be immediately destructive to organic existence; vegetation would cease; the supply of oxygen gas would be immediately cut off from animals; the lower strata of the atmosphere would become composed of carbonic acid; and perception and volition would exist no longer."† Although these views were expressed more than eighty years ago, very little progress has been made in the direction they indicate.

Such considerations as these suggest that he who would truly ascertain and measure the energy of light—that energy upon which all terrestrial life depends—must look to do so in its influence on organised beings; he must either separate the allied influences, or he must so separately estimate these that he can apply his estimate correcting a general result by a process of common occurrence—viz., the eliminating of all foreign or allied energies, and thus give to science the true energy of true light. He who, with knowledge and patient skill, enters upon this hitherto almost unexplored and yet noble field of investigation and research, will give to the age in which he lives, and transmit to future generations, that which will indeed be a boon to all. Pending the coming of that time when some science investigator, possessed of sufficient knowledge, humility, originality, and skill, shall do for light what Newton, Atwood, and Kater have done for the measuring of the energy of gravity—what Mayer, Joule, and Thompson have done for that of heat—what Haughton has done for that of vitality, and what Siemens, Matthieson, Jenkins, and others have done for electricity—what Davy, Dalton, and others have very partially done for that of affinity, and what Bunsen and Roscoe have done for the chemical energy of light—but what no one has yet done for that of light, properly and exclusively so called—we must content ourselves with such modes of estimating this energy as are at present known and available.

This energy is supposed to be manifested in the promotion and facilitating of chemical affinities. These affinities (as doubtless some present remember) vary in their character as one or more of the "imponderables" are combined in their promotion. So much is this the case that chemical notation now adds, in reference to certain indicated changes, the words, by heat or electricity, as the case may be. There are, however, certain affinities called forth under the influences of light which do not show themselves under any other conditions. As, for example, certain of the salts of silver (such as silver combined with chlorine, iodine, or bromine) change their colour and their character, the silver being set free from its combination as a black powder. There is also that power, which plants in the presence of sunlight possess, of changing the carbonic acid gas, which, if allowed to accumulate in the atmosphere, would soon render it unfit to be breathed, into its constituent elements, the plant retaining the carbon and ejecting the oxygen. Priestly, in 1790, that is, at the period when Davy wrote the article from which an extract has been read, a period when, for a short time, men's minds were being directed to this department of scientific research, was the first to show that plants kept the atmosphere pure and healthy, but he

* [illegible]

† Davy's Works, vol. ii., p. 106.

could not calculate. His was rather a qualitative, and not a quantitative result.

Changes in the colour of salts of silver, through some energy of light, have been observed since the middle of the sixteenth century. In 1777, Scheele suggested some explanations which, although very imperfect, are as yet the only recognised ones. In the early part of the present century experiments of a similar kind were made at the Royal Institution by Wedgwood and Davy.* The absence of any mode of fixing the impression caused the results to be very evanescent, but the localising of this peculiar property of light is clearly announced in these words:—"Red rays, or the common sunbeam, passed through red glass, have very little action; yellow and green are more efficacious, but blue and violet light produce the most decided effect."

The rapid development of the art of photography during the past twenty or thirty years has led enthusiasts in this branch to overlook the purely chemical character of their art, and to attribute the changes with which they deal to a manifestation of the energy of light. Hence scales have been devised which may enable photographers to adopt some kind of a standard. They are not, however, worthy of the name of scales of energy, as they depend upon the power of the eye to appreciate very slight differences in shade. A scale or measure, to be of general use, should be of such a character that a person in one part of the world writing to one in another might refer to some common standard.

There is, however, a process for obtaining a measurement of one element in the energy of light capable of greater accuracy of observation than the photographic one. This also is chemical.

In the lecture on the energy of affinity a brief time was devoted to the peculiar manifestation of affinities under the conditions of the nascent state.

It is apparently a deviation from this form of energy when the two well-known gases, chlorine and hydrogen, are produced and intimately mixed, either in their nascent state or afterwards, in the dark or in the presence of that portion of the solar beam we call red. Under these conditions no rapid union of the gases takes place. Permit the evolution or the mixing of the two gases to be in ordinary light, properly so-called, and an intimate union, or rather an actual chemical combination, is a consequence.

If these gases be separately produced and collected in a glass vessel in equal parts, the union and formation of a new chemical compound in this glass vessel follows from exposure to light. If the light, or rather that particular portion of the solar beam to which chemical action is generally attributed, be permitted to act upon the two mixed gases, then the union takes place at a rate determined by the energy of some one or more of these constituent elements of light on which the combination depends. Where in the solar beam these constituents are is a question easily solved.

Every ray, or every portion of a beam of light, is capable of producing union between hydrogen and chlorine; but the combination takes place at very different rates, according to the portion of the beam which acts upon the united gases. The actinic portion will act seven hundred times as rapidly as the heat portion. That is to say, a certain combination will take place under the influence of this portion in one minute, which it will take more than eleven hours to accomplish under the influence of the heat portion. Therefore, by separating the ray of light, we can graduate the rate at which the combination occurs. Here are some glass bulbs containing chlorine and hydrogen which have never yet been exposed to the light. If one of these be placed under this globe of red glass, then the light that passes through it will be the portion of light corresponding to the heat end of the spectrum, and it will take hours to accomplish the perfect union of these two gases. If, however, one be placed under a globe of a blue colour, the light falling upon it will represent that belonging to the actinic portion of the spectrum, and the gases will unite (if the experiment be successful), and explode in about ten seconds.

Whilst recognising this test and measuring gauge of the chemical brightness of certain lights, it must be borne in mind that it is chemical action, and not the energy, of light, properly so-called, that is measured. For instance, when the brightness of the sun's disc, as a case of light-brightness, is 520 times that of magnesium wire, the chemical brightness has been found to be not forty times as great.

Here are diagrams of two spectra, one of which is obtained from flint-glass. Now, flint-glass produces an effect which is considered to be due more to the physical property of density than to the elements of which it is chemically formed. Assume this diagram to be a faithful reproduction of the spectrum from flint-glass. Now, however similar another glass may be in appearance, yet if it differ in density and constituent elements the distances between certain lines in the spectrum may in some portions be the same, but in others they will differ. If, therefore, light be estimated from the spectral appearance of it after it has passed through any substance, it is clearly subject to the influence of that substance. Again, on another diagram is a series of colours produced by a process called diffraction. This is the apparatus, and this is the mode of producing those colours. At the object-glass end of the telescope there are a number of very fine lines drawn, and if the telescope be directed to a very intense speck of light, such as the reflected sun from a small silvered globe or the bulb of a thermometer, coloured bands are seen, containing the same colours that the flint glass spectrum shows. But the colours seen under this diffraction arrangement are very different in quantity to those seen under any other arrangement. A diffraction experiment is easily made by each for himself. From that hook a bright reflecting silvered glass globe is suspended, and two or three smaller ones of the same kind. If anyone is tired of listening, and feels disposed to go to sleep, they can perform this experiment very easily. Just close your eyes and allow the eyelash to interfere with that speck of light reflected from the globe, and you will probably see colours radiating on both sides. Those are colours due to diffraction, and there are modes by which they can be made to appear much wider apart than by the one now described. Taking the diffraction spectrum, we find that these distances, from D to E, say of the yellow portion of the spectrum, are not of the same length as the corresponding portion in the flint glass spectrum, and the same with the other portions, so that the proportions are quite altered. This is called the "irrationality" of the spectrum. Line D there becomes the middle of the spectrum instead of being, as it is here, very near to one end. The consequence is, when we talk of there being no heat in this portion of the spectrum, we have really and truly distributed the heat which ought to be condensed in F, G, over that large space, and therefore it shows on a fixed area much less heat than it would do not so distributed. If, now, these apparently unequal halves of the spectrum be examined for heat, it will be found that collecting them into two separate foci, the heat in the one focus is equal to that in the other. Clearly, had these portions been examined over equal areas the heats would not have been equal. Therefore the notion generally entertained of heat being confined solely to one end of the spectrum is not strictly true. That diffraction spectrum explains it, and there are other matters bearing upon it which, if time permit, shall be referred to presently.

That kinetic energy, of a character as important as any found in the other imponderables, exists in light, may be inferred from the fact that, if light be extinguished by falling upon such a surface as lamp-black, the stoppage of the ray—the consequent absorption of it—produces heat. The motion of the light has been converted into a motion called heat. If, however, the light be stopped by some of the salts of silver, then this

* *Journal of the Royal Institution* for 1802, p. 170.

motion is converted into chemical changes. The heat and the change are consequences of an energy in light. Nor is it only when influencing different substances that light effects different results. Take, for example, carbon, and note how varied is its behaviour towards light and electricity. When in the form of a diamond, then carbon transmits light and stops electricity; but when in the form of coke, into which the diamond is transformed by heat, then carbon transmits electricity, but stops light. No cause has yet been assigned to that which seems almost universally the case, viz., transparent bodies stop electricity—carbon, the metals and opaque bodies, stop light.

It is a popular opinion that sunlight or sun-brightness extinguishes household fires. May not this be from some hitherto undiscovered energy of solar light, for it is not the heat of the solar beam which thus causes the carbonaceous fuel in our grates to become dim? If the energy of light is to be studied, and its value to be estimated and brought within our powers of utilisation, it must be done through agencies widely different from those hitherto named. Looking at the order of creation, and watching the behaviour both of the animal and vegetable kingdoms, it seems that through them must be had our knowledge. Allusion has been already made to these. It may be well to investigate more closely the relation of the energy of light to them. No mode of measuring the energy of light in relation to animal life has been suggested, and yet its energy in this respect is more strikingly extraordinary than that of the other imponderables. Take one illustration only. When you knock at the door of a friend's bedroom, and receive no answer, how loud, and louder still, becomes the rap ere he awakes. How often are stories told at the breakfast-table of night noises unheard and unheeded by those asleep. Let but a beam of sun-light, or even candle-light, shine on the closed eyelid, and by some mysterious energy on the well-covered retina the sleeper awakes.

The worlds of animal and vegetable life awake and work mainly in consequence of some such hitherto unmeasured energy of light as that now alluded to.

Turn to vegetable life. With respect to this, Professor Helmholtz remarks:—"Take a seed, then look at the tree, and consider from what source has been derived all the material of the tree. Burn the seed, burn the tree, whence comes the different amounts of heat? Chemistry tells us that the heat is produced from carbon, oxygen, and hydrogen; these are derived from carbonic acid and water. Plants cannot obtain these except under the influence of solar light."*

After plants have utilised the light it is not useable again for the same purpose. Take two screens of dark paper, such as these, with holes in them—say half an inch in diameter—one hole covered with letter-paper, the other covered with a green leaf; put pieces of photographic paper behind them, and expose to day-light or magnesium light. Beneath the letter-paper is a dark spot—an image of the hole; beneath the leaf is no discolouration. The leaf has utilised the light, the letter paper has not. The energy of that which passes through the leaf is spent, of that passing through the paper is not spent.

Although in plants a variety of operations take place, which must in some way unknown to us store up a large amount of energy, and although there is to all practical purposes no heat developed, yet we know well that there are thus stored up chemical tensions which give out their true physical value in heat and mechanical work, as the tissues of the plants are destroyed by a process of animal or other combustion. We are as yet quite at a loss to know how the plants do this, or by what elements in light, properly so called, it can be so completely and perfectly done.

Sir John F. W. Herschel, in a paper in the *Philosophical Transactions* for 1842, gives a most interesting account of an extended series of experiments on the action of the solar spectrum on vegetable colours. He operated upon the juices of the leaves, and also upon some of the resinous compounds of plants, and his conclusions have since been confirmed, viz., the action of the solar spectrum is confined to the visible region of it. The chemical or actinic rays act with chief energy upon silver or inorganic compounds, but are, for the most part, powerless upon vegetable colours: so also are the heat rays, or those below the extreme red. Thus Sir J. Herschel, in 1842, separated by a very broad line the luminous portion of the solar beam from the other parts of it. That the energy of the luminous portion of the solar beam is requisite ere plants can exercise their vital functions is well known to all who have made any of the experiments which show the extent to which, under the influence of that energy, plants can effect chemical changes. These changes take place most abundantly in the yellow, or in what our eyes would call the brightest, portion of the spectrum.

The energy of this luminous portion may be gathered from experiments made during the last few years by an American. Flowering plants were placed in different colours of the spectrum, and it was soon observed that their action upon carbonic acid gas depended upon the colour of the spectrum. He took a flower, and under the action of a red ray he did not get 1 cubic inch of gas off, but only 0·33 of an inch. As soon as he submitted that same plant to the orange ray, he got 20 cubic inches, and from the yellow he got 36 inches. But when the same plant was put under green, blue, indigo, or violet, he could not get the plants to act at all in the purification of carbonic acid gas, thereby showing pretty clearly the energy of light in the luminous portion of the spectrum as regards growing plants.

The decomposition, then, of the carbonic acid is effected chiefly by the energy resident in what may be called the yellow rays. It is a somewhat noteworthy coincidence, that the eye generally fixes upon the yellow portion of the spectrum as that possessed of the greatest brilliancy; it is also noteworthy that the spectroscope reveals *that* in the atmosphere (viz., sodium) which, on being burnt, always produces a yellow band. It is, to say the least, curious that we cannot get heat by combustion in the air without the production of this yellow light.

It seems, then, that plants and human eyes are most sensitive to the same portion of the solar beam, and this portion is in light properly so called. May it not be that yellow light is most acceptable to the plant, and most impressive upon us, because carbon is in both cases involved—the retina of the eye being a carbonaceous compound? Had the retina been a salt of silver, then the greatest brilliancy would perhaps have seemed to be in the blue rays.

This identity in composition between the plant and that part of the animal on which light exercises its chief energy, suggests that in the influence of light on plants (whatever that may be) must be sought the data from which to deduce a mechanical rather than a chemical measure of the energy of true light.

The contrast of this energy in its effect upon the metal salts and plants is especially marked as regards time. On the metal salts it may be said to be instantaneous, but on the gums and resins of plants exposure for days and months to clear sunshine is needed to produce any marked action. A patient watching and building up on such scant data as may hitherto have accumulated will some day produce the dynamical equivalent of light.

There is one experiment here which will probably bear out what has been said. You are probably aware that plants, by receiving light, manufacture what we name colour. They manufacture the green material out of which the leaves and the general character of the plant is formed, and that green material is called "chlorophyll." This vessel consists of two beakers with the bottoms cut off, one about an inch and a

* Helmholtz, *Medical Times*, 30th April, 1864, p. 473.

half larger than the other. The glass cylinders then left are fixed with marine glue in a wooden ring. The space between them is filled with a solution of chlorophyll, obtained by steeping for forty-eight hours common parsley in any cheap spirit, such as methylated alcohol, and then filtering. It therefore contains the green colouring matter of leaves. This green colouring matter has been made almost exclusively by the yellow portion of light, and not at all by the chemical portion, and, with a view to show this, we must refer to the spectroscope view, namely, that chlorophyll, being really manufactured by yellow light, is practically saturated with yellow, and can take up no more. Thus, if a vessel containing a saturated solution of salt had a piece of salt dropped into it, that piece would not dissolve. If, now, there be placed inside this chlorophyll solution anything that produces these other coloured rays, we shall probably find that, while sensitive to the one colour, the solution will not be to the other. Here is some lithium, which shall be placed on a little piece of platinum wire and burnt, so causing a beatiful red flame. On putting the flame within the hollow cylinder containing the chlorophyll, you will see the yellow beam alone can pass through the green solution. The green solution having been made with that yellow beam, is thoroughly saturated with it, and can take up no more, but it can take up the other coloured rays, and therefore they do not pass through. In that portion of the flame rising above the green solution you see the red-coloured flame. Thus the yellow colour is consequent upon the saturated solution of chlorophyll, and therefore nothing but yellow can come through. The absorption of this yellow portion of the solar spectrum, by the vital energy of the plant and utilising the same in its composition, might have been inferentially suspected from the fact that leaves become yellow in the autumn, thus restoring in their death what, for want of a better term, we must call "the colour" they had absorbed in their life. The yellow colouring matter of the autumnal leaf is called "xanthophyll." Probably, as "chlorophyll" and "xanthophyll" are more examined and known, so the energy of light may be more appreciated and measured.

This examination of light, properly so-called, has led to another contribution towards an estimate of the energy. That plants grown in the dark are drawn to any crevice through which light enters has long been known. But it has not been so often observed that young plants bend the stems to the indigo portion of the spectrum, *i.e.*, if grown in red, or yellow, or green, they bend in one direction, but if in the violet, then in another direction. They recover the vertical position in darkness. May it not be that the energy in the indigo of the sky produces the vertical character of stem?

Thus light proper produces motion, and so assimilates itself to heat and electricity. The complementary colours of red and green (see the chromatic circle of Newton on diagram) are those which represent the relation of colour between the animal and vegetable kingdom. Plants reject green and absorb its complementary (red). The blood of animals is red, therefore animals should have green supplied in the fields and in our furniture.

That this energy of light is utilised in vegetation, and that practically we recognise it, may be noted in the ingenious modes by which in our small gardens we try to imitate nature. The nailing of branches on walls—an advance on this in espaliers on lattice woodwork, and the still more recent practice of cutting out the inner branches of orchard apple trees; also training others to hang in umbrella rashion, or the splaying of gooseberry bushes as funnels, all these are devices to permit of the more universal exercise of this unmeasured energy of light.

Light influences the colour of animals and the plumage of birds in tropical climates. In the arctic regions polar bears are white, like vegetables grown out of the influence of light—arctic foxes are white in winter and brown in summer. Fishes inhabiting deep water chiefly are grey, or brown, or black; those living near the surface are of rich and various colours.

That the measurement of the energy of true light should be by an appeal to its influence on organised matter, and not on inorganic, is a testimony borne by all observations, and even suggested by the records of Creation, the earth having been prepared by the creation of light for animal and vegetable life even before they were formed upon it. This measurement has not yet been made.

(To be continued.)

CORRESPONDENCE.

THE CHEMICAL SOCIETY'S NEW ROOMS.

To the Editor of the Chemical News.

Sir,—Your correspondent "Ventilator" has given expression to the general feeling of dissatisfaction with which the *habitues* of the Chemical Society view its new meeting-room. The room in itself is well enough, but the way in which it is lighted and fitted is a disgrace.

Chemists are credited with a knowledge of the principles of sanitary science, and it seems incomprehensible why these should be so violated in the room over which chemists have control.

The trooper who, on the march to Coomassee, experiences an attack of sun-stroke will be cared for by a grateful country. But what will the grateful country think of the votary of Science who experiences an attack of gas-stroke at Burlington House, especially when she hears the victim is a chemist, and it has occurred in the chemists' special quarters.

I write more in the interest of Fellows non-resident in London, who are not quite up to the doings of their metropolitan brethren, and strongly advise all such who contemplate visiting their meeting-room in Burlington House to bring a flask of cold water, a slaked lime respirator, and an umbrella.—I am, &c.,

Slaked Lime.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, November 10, 1873.

Action of Lead upon Water.—M. Dumas.—The author describes a former experiment in which five bottles containing leaden shot were partially filled with the following waters respectively:—Distilled water, rain-water, Seine water, Ourcq water, and well-water. It was found that the one containing distilled water showed in a very short time traces of lead in solution, whilst the waters charged more or less with calcareous salts contained none. The rapidity with which pure water acts upon lead is surprising, and the effect produced by traces of lime in preventing this reaction is not less so. It is impossible not to be reminded of Schlœsing's observations upon clay, which, in pure water, remains indefinitely suspended, but which is precipitated by the slightest trace of lime salts.

The author thinks that pure water is an agent not yet perfectly known, and that its properties differ from those of common water more than is suspected. In the conversation which followed, M. Elie de Beaumont remarked that Schlœsing's observation explained fully the clear and sparkling character of calcareous waters.

Absorption of Ammonia by Saline Solutions.—F. M. Raoult.—Among the saline solutions reputed indecomposable by ammonia, there are some which, as they are saturated with this gas, lose the faculty of holding in solution all the dissolved salt, and deposit it in the form of crystals, which may, or may not, contain ammonia. There are others which, although concentrated, deposit nothing under these circumstances; the experiments of the author refer to the latter. The results show that the solubility of ammonia in solutions of potassa is less than in pure water, in proportion as such solutions are more concentrated. Solutions of soda act exactly like those of potassa of the same strength. Solutions of nitrates of soda and of ammonia absorb just as much ammonia as pure water under the same circumstances. Dry nitrate of soda absorbs not a trace of ammonia, while nitrate of ammonia takes up a considerable quantity. Solutions of nitrate of lime absorb more ammonia than does water, though there is no evidence either of decomposition or of combination. As to the effect of the degree of concentration of solutions upon the quantity of ammonia absorbed, the author proposes the following law:—The difference between the coefficient of the solubility of ammonia in water, and in solutions more or less concentrated of one and the same salt, is proportional to the weight of salt contained in a constant volume of the liquid, measured before the absorption of the gas. This law may meet with exceptions for the extremely concentrated solutions of some bodies, such as the hydrates of potassa and soda, but it holds good for all whose boiling-points do not exceed 110° C.

Presence and Determination of Titanium and Vanadium in the Basalts of the Neighbourhood of Clermont-Ferrand.—M. V. Roussel.—The author finds the above basalts richer in titanium than any hitherto examined. The samples, in fine powder, were fused with thrice their weight of carbonate of soda; the mass, when cold, was powdered, and treated with water acidulated with hydrochloric acid; it is evaporated to dryness, heated for twenty-four hours on the water-bath, treated anew with acidulated water, and then filtered. The silica eliminated is, after calcination, set to digest for twelve to eighteen hours in hot concentrated sulphuric acid, treated after cooling with an excess of cold water, and filtered. This operation is repeated, and the total liquid is mixed with ammonia, which throws down titanic acid. It is filtered, washed, and ignited. The liquid separated from the silica contains also titanic acid; to separate it, it is treated with sulphate of soda, sulphurous acid, and hyposulphite of soda, boiled for twenty minutes, and there is left the mixed precipitate of sulphur, alumina, and titanic acid. The sulphur is driven off by gentle heating, and the residue is mixed with the former precipitate, and digested in a sealed tube with pure, hot, concentrated hydrochloric acid, in order to eliminate the alumina. After this series of operations, the titanic acid is pure, and may be dried and weighed. The same basalts contain vanadium, but in a far smaller proportion. To obtain a ponderable quantity, it is necessary to operate upon a sample twenty times larger than is required for the detection of titanium. The basalt is melted with carbonate of soda, and the mass oxidised with a little saltpetre. After cooling, the pulverised mass is treated with a large quantity of boiling water, filtered, and washed perfectly. The liquid is evaporated, boiled with carbonate of ammonia, and filtered, treated with hydrosulphate of ammonia, and left to settle for two or three days. If the solution contains vanadium, at this moment the fine red colour of sulphide of vanadium when dissolved in an alkaline sulphide appears in the liquid. It is filtered, and hydrochloric acid is poured into the liquid, which throws down sulphide of vanadium mixed with sulphur. The latter disappears on careful heating, when the sulphide of vanadium, VS_2, is weighed. The largest percentage of titanium was 2·378, and that of vanadium 0·023.

Determination of Sugar by means of Iron.—E. Riffard.—This method has been already noticed in the CHEMICAL NEWS.

Examination of Law Proposed by M. Helmholtz to Represent the Action of Two Elements of a Current.—M. Bertrand.

Action of Water on Lead Pipes.—M. Belgrand.—This note goes to prove the innocuity of lead pipes in the Paris water service. Of the public pipes, there are only 3000 m. of lead out of a total of some 1,400,000 m. The branch pipes for domestic use have a total length of 1,580,000 m., but in this network each litre of water traverses only from 5 m. to 100 m. of lead, and, where the house is inhabited, the water is but a short time in contact with the lead—nine hours at the most (in the night). In the 3 kilometres of public pipes, the interior surface is quite smooth, and without trace of erosion, even in pipes 200 years old. The branch pipes have a thin adherent crust (lime, &c.), which hinders the contact of water and lead. M. Belgrand further made a series of analyses of water used in delling-houses, and found no traces of lead. His *collaborateur*, M. Le Blanc, experimented on a longer contact of water with lead; and his tables show that very pure water, such as that from the wells of Grenelle, though possessing much less saline matter than the Seine water, has yet the property of preserving lead from oxidation during long contact. Rain-water, even, does not attack the lead, unless it has been received after a sort of prolonged washing of the atmosphere by rains. When it is become insensible to the action of reagents of lime, it begins to attack the lead rapidly, like distilled water. Salts of lime, in the most minute quantity, notably prevent the oxidation of lead in contact with water. The general conclusion M. Belgrand arrives at is that the danger in Paris is *nil*, and that it is not desirable to substitute other pipes for the lead.

Historic Point Relative to Animal Heat.—M. Berthelot.—The point is, that M. de Lagrange was right in supposing, in opposition to Lavoisier, that animal heat was not wholly produced in the lungs, but wrong in his grounds for this view, which were that the organ would in that case have been in danger of destruction.

Establishment of a Meteorological Observatory at the Foot of the Pic du Midi by the Ramond Society.—M. Deville.

Note on Magnetism.—M. Gaugain.—The author, starting from an observation by M. Haecker, experimented on the changes in a horse-shoe electro-magnet when its armature is detached. A current was passed, the armature applied, then detached, then the current broken, and the armature applied and removed several times successively. The decrease of magnetism was measured by the author's method of induction currents, and these currents of demagnetisation were, for the first, second, third, fourth, and twentieth separation successively, 176·0, 19·5, 16·0, 14·5, and 13·4. When the armature has been applied and detached twenty times, the magnetism is not varied, though the process be repeated ever so often; and if the magnet be then put aside, with or without its armature, it will be found after some months in the same state as when left. Thus, in speaking of the magnetism acquired by iron in different conditions, it is necessary to mention the number of separations of the armature after the source of magnetisation has been suppressed. There are circumstances (M. Gaugain proceeds to point out) in which the separation of the armature seems to increase the magnetisation. Having brought an electro-magnet to the above constant state (Haecker), he determined the current

of detachment *(d'arrachement)* developed by this constant magnetism. The series of operations indicated having been repeated fifty times, he found the value of the current at the end of each series increase as the operations were multiplied, at least to a certain limit. It rises to the extent of a fifth of the value obtained at the end of the first series. This increase does not depend on the time during which the reducing current circulates; it is the same when this passes for an hour and for only a few seconds. The increase does not occur when one interrupts and renews the inducing current a number of times without detaching the armature. The armature must be detached after each of the interruptions of the inducing current. It might thus appear that the detachment of the armature increases the magnetisation, but this the author does not consider a true interpretation of the facts.

Aqueous Exhalation of Plants in Air and in Carbonic Acid.—M. Barthelemy.—The author experimented by an improved form of Mariotte's method, placing a branch in a closed receiver, and measuring the water condensed. He considers the aqueous exhalation may occur in three ways—(1) By insensible exhalation over the whole cuticular surface, through a veritable gaseous dialysis; (2) by a sudden emission of saturated gases, which escape by the stomata when the plant is subjected to a rapid elevation of temperature (especially in a receiver); (3) by accidental exudation, arising from deficient equilibrium between the absorbent action of the roots and the work of the aërial parts, and fixation of carbon added to the elements of water, a work which ceases with the light. He further concludes that heat exercises a great influence on this function, and that, with equal temperature, carbonic acid in presence of light, has the effect of diminishing the evaporation.

New Researches on the Upward Passage of Nutritious Matters in Bark.—M. Faivre.—(Extract).—The experiments consisted in making annulations, partial or complete, on the stems and branches of mulberries, walnuts, and cherry-laurels; also valves or tubes of bark separated from the wood and bearing buds; and in combining complete annulations with partial, or with valves or cortical tubes. Direct evidence was obtained of the ascent by the bark.

Influence of Drinking-Water in the Propagation of Cholera.—M. Colin.

Several Cases of Intermittence of the Voltaic Current.—M. Cazin.—The first experiment was briefly this—A coil, connected with a battery, passed round an iron tube; the circuit could be opened or closed by a platinum point, which dipped in mercury. If, the platinum and mercury being first separate, they were put in communication with the armature of a condenser, or if a layer of alcohol was interposed between the mercury and the platinum point, a continuous sound was heard in the iron core (it ceased if the alcohol was suppressed or the point dipped in the mercury); this indicates that the current passed through the glass in the former case, through the alcohol in the latter, and that its passage was intermittent. The iron core undergoes a rapid series of magnetisations and demagnetisations. The author thinks the cause of the intermittence is the condensing action of glass and of alcohol. When the two faces of the insulating substance have acquired a certain electric potential, a discharge takes place through the insulating layer. The magnetism of the core grows during the charge of the condenser, and diminishes during its discharge. The sound is produced during the diminution of magnetism. The second experiment refers to the spark of rupture, which, produced in alcohol in the above arrangement, is observed to be compound, and the sound it gives prevents a similar mode of division. The production of a sound in the condenser also proves that there is a partial discharge through the insulating matter, although this appears nowhere to be perforated. In a third experiment, the platinum point could be moved up and down in its support by screwing. Dipping in the mercury, it is gradually raised till the spark passes through the alcohol; then a succession of sparks occur, and continues some time. The surface of mercury evidently oscillates under the point. One possible cause of this is that, the spark being formed by mercury vapour, the elastic force of this vapour depresses the surface of liquid. The latter returns to its original level, passes it in virtue of acquired velocity, and rejoins the platinum point; falling back, it produces a new interruption, and so on. But this cannot be the only cause, for the circumstances favourable to this automatic interruption are those which accompany the decomposition of the spark of rupture into a small number of bright successive lines. By changing the extent of the condenser, one may change the number of divisions in the spark; if the condenser be suppressed, there will merely be a crepitating voltaic arc. Probably the period of oscillation of the mercury and the intermittence of discharge of the condenser are in mutual dependence. The crepitations of the ordinary voltaic arc are, the author thinks, a phenomenon belonging to the class above indicated. All the facts permit of being united by the following proposition:—The interposition of a suitable resistance in the voltaic circuit causes intermittence of current. Further, the important conclusion is warranted that the current is a succession of modifications which are accomplished periodically in the circuit.

Process of Determining the Nodes in a Sounding-Pipe.—M. Bourbouze.—The author substitutes, for M. König's capsules, a simple membrane of flexible caoutchouc, to which he attaches a light silvered mirror, which oscillates with it. A ray of light is reflected from the mirror, and figures like those of M. Lissajou's are obtained. The image has its maximum of elongation when the mirror is at a node.

Action of Aërated Water on Lead, considered with reference to Hygiene and Legal Medicine.—M. Fordos.—The author's remarks are partly directed against the employment of lead in rinsing bottles.

Influence exercised by the Moon on Meteorological Phenomena.—M. Marchaud.—From examining the distribution of storms in the country between Paris and La Manche, from 1785 to 1872, M. Marchaud finds an appreciable relation to the age of the moon. Thus the probabilities of appearance of storm phenomena are great the tenth, fourteenth, and fifteenth days of the moon—especially the tenth; they are appreciable upon the eighteenth; well marked at the twenty-first; decrease from the twenty-second, and again become very important in the three days which precede or which follow the neomenia. On the other hand, the probabilities descend to their minimum on the twentieth and twenty-fourth day, but above all the sixth. The author also shows, by tables, &c., that the moon has an appreciable influence on thermometric and barometric changes, on the state of the sky, and the distribution of rains.

Processes for Determining the Direction and Force of the Wind, Suppression of Vanes, Application to Cyclones.—M. Tany.—Vanes have three faults:—(1). They indicate a direction when there is no wind. (2). They do not indicate the force or velocity of wind. (3). They only show the horizontal component, not the real direction. The author substitutes a light resistant bandrol, or little flag, suspended by a cord from a metallic ring, pulleyed on a vertical rod.

Bulletin de la Societe Chimique de Paris, tome xx., Nos. 8 and 9, November 5, 1873.

Assay of Plumbiferous Mammals.—J. Loewe.—In treating lead ores with nitric acid, a loss generally results from the formation of insoluble sulphate of lead. The solubility of this salt in hyposulphite of soda renders it possible to avoid this inconvenience. After treatment with nitric acid the residue is exhausted with boiling

water, until the soluble salts and the acid are completely eliminated. It is then digested in the cold with a concentrated solution of hyposulphite. After this treatment has been twice or thrice repeated, the residue is exhausted again with water; the lead is then precipitated from the filtrate by sulphuretted hydrogen or sulphide of ammonium: to facilitate the agglomeration of the precipitate and its washing, it is heated in the water-bath. The sulphide is then converted into sulphate, and its weight added to that of the sulphate obtained directly.

Separation of Uranic Oxide and Phosphoric Acid.—E. Reichardt.—This separation can be effected by dissolving the phosphate of uranium in carbonate of soda, and precipitating with a salt of magnesia. If the precipitate of phosphate of uranium is old, it is necessary to dissolve it first in hot concentrated hydrochloric acid, adding nitric acid to peroxidise any iron present. The solution is then heated, and soda added in excess. After a new filtration the phosphoric acid is thrown down by adding ammonia and chloride of magnesia. After twenty-four hours, the liquid is separated from the ammoniaco-phosphate of magnesia. It is acidified with hydrochloric acid, heated, and the oxide of uranium precipitated by ammonia, avoiding excess.

Separation of Molybdic Acid from Phosphoric Acid.—E. Reichardt.—This separation is effected in a manner analogous to the former. The phospho-molybdic compound is dissolved in carbonate of soda, and heated to boiling. After having precipitated the phosphoric acid by means of magnesia-mixture, the solution is treated with *aqua-regia*, and evaporated to dryness to expel excess of acid. The residue is then treated with water, which leaves the molybdic acid undissolved.

On Certain Derivatives of Cyanoxycarbonic Ether.—A. Weddige.—Alcoholic ammonia acts upon cyanoxycarbonic ether, yielding a well-crystallised body, which the author had regarded as the corresponding amid. A new examination convinced him that in this case cyanide of ammonium and urethan were formed. Aniline acts in an analogous manner, and yields hydrocyanic acid and carboxanilidic ether. Methylamin appears to act in a similar manner. Hydrochloric acid decomposes cyanoxycarbonic ether, slowly in the cold, producing oxalic acid and an ammoniacal salt. If sulphuretted hydrogen is passed into the alcoholic solution of this ether, yellow crystals are separated, which crystallise from common ether in fine lemon-coloured prisms, and from boiling water in fine yellow needles. This compound fuses at 63° to 64°. Sodium yields, with cyanoxycarbonic ether, brown, viscid products. If left in contact with an equivalent of bromine, moisture being excluded, this ether yields, after the lapse of two days, long needles, which are obtained in greater quantity if the mixture is heated in a sealed tube to 100° to 110°. After crystallisation from boiling alcohol, this body forms small, white, hard prisms, fusible at 164° to 165°, and very sparingly soluble in water and ether. They form a polymer of cyanoxycarbonic ether. Boiling alkalies decompose these crystals, yielding ammonia and oxalic acid.

On α-Cresyl-disulphurous Acid, and on some of its Derivatives.—P. Hakausson.—By the action of fuming sulphuric acid upon cresyl-sulphurous acid, the author has obtained two cresyl-disulphurous acids, α and β. He considers the acid α isomeric with the cresyl-disulphurous acid obtained by Senhofer. The author has examined its potassium, sodium, ammonium, barium, calcium, magnesium, aluminium, manganese, cobalt, cadmium, nickel, zinc, lead, copper, and silver salts, its chloride and amid, the disulphydrate of tolylen, and disulphobenzoic acid, with some of its salts.

Modification of Nutrition after Loss of Blood.—M. Bauer.—A physiological paper.

Chemical Study on Fever.—M. Manassein.—The author shows that during fever the digestive power of the gastric juice is very slight, but increases on the addition of an acid.

Case of Poisoning by Arseniuretted Hydrogen.—M. Troost.—Arseniferous zinc, used in separating silver from lead at Stolberg, proved fatal to three of the workmen. Arsenic was detected in the viscera and the fluids of the bodies.

Detection of Metals in the Organism.—MM. Mayençon and Bergeret.—The tissue is treated with aqua regia, and a galvanic couple, consisting of an iron and a platinum wire, is plunged in the liquid. After thirty minutes, the couple is withdrawn, washed in distilled water, dried, immersed in chlorine gas, shaken in the air to get rid of the chlorine, and the platinum is finally rubbed with paper soaked in a solution containing $\frac{1}{100}$th of iodide of potassium. Mercury produced a red, and lead a yellow, colouration, &c.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of glass mirrors, and in apparatus or grinding and polishing plate glass, also in engraving on glass. Thomas Brown, 96, Newgate Street, London. (A communication from Edouard Dodé, Paris.) March 5, 1873.—No. 802. This Provisional Specification describes apparatus for grinding and polishing plate glass, also coating rough glass with a platina enamel, and subsequently platinising such enamel; also engraving or ornamenting glass by the use of boracic acid applied to the surface of the glass in any desired pattern, the glass being afterwards submitted to sufficient heat to fuse the acid.

Improvements in the treatment of blood for the manufacture of manure. Leonce Oscar Durruthy, and Henri Prosper Lissagaray, both of No. 20, Rue des Petits Hotels, Paris. March 6, 1873.—No. 809. This invention consists in treating blood with hydrochloric, nitric, sulphuric, sulphurous, or other mineral acids, or with sulphites, especially sulphite of soda.

Improvements in drying and roasting malt, grain, and other substances. George Phillips, 71, Tufnell Park Road, Islington, Middlesex. March 6, 1873.—No. 821. This Provisional Specification describes special means of applying hot air under pressure for drying and roasting malt, grain, and other substances.

Improvements in apparatus employed in the concentration of sulphuric acid. Henry Bernoulli Barlow, patent agent, Manchester, Lancaster. (A communication from Nicolas Joseph Galland, engineer, Paris.) March 7, 1873.—No. 827. This invention consists first in the mode of constructing the vessels in which the sulphuric acid is concentrated, and secondly to the general arrangement of the concentrating vessels, the apparatus for agitating the acid, the manner of applying heat to the vessels and the pipes for connecting them together, and to the cisterns in which the vapours are condensed and the acid is collected, and the pump for forming a partial vacuum. The concentrating vessels are made of cast-iron, lined with lead or other suitable soft metal.

Improvements in the manufacture of sulphates of soda and of potassa, and in the production of chlorine. James Hargreaves, chemist, and Thomas Robinson, iron founder, both of Widnes, Lancaster. March 7, 1873.—No. 828. The patentees avail themselves of the same reactions which occur in roasting cupreous pyrites with common salt preparatory to separating copper by the well known wet process, but they keep their chlorides free from contact with large masses of oxide of iron. Copper, or a salt thereof, is added to chloride of sodium or potassium, and the mixed mass exposed to the action of sulphurous acid gas and atmospheric air. The chloride is converted into sulphate, and chlorine set free. The chlorides may be moulded or broken into suitable pieces. Manganese or chromium may be used instead of copper. The means and apparatus preferred are described in previous patents, Nos. 3045, 3047 (1870); 1733, 1854, 1920 (1871); and 3052 (1872).

A new or improved amalgam for the better imitation of silver. John Keene, Scott's Yard, Bush Lane, Cannon Street, London. (A communication from Madame Pirch Baudvin, Rue des Marais, Paris.) March 8, 1873.—No. 834. The novelty in this case consists in the peculiar selection of metals and their relative quantities, especially the introduction of cobalt, to form an amalgam resembling silver.

Improvements in utilising refuse matter for the manufacture of fuel and manure. James Wadsworth, machinist, Manchester. March 8, 1873. No. 841. The features of novelty in this invention consist in taking street sweepings, ashes and cinders, coke from gas works, mud from sewage and foul river settling beds; and, when necessary, adding a portion of clay to give a proper consistency. I then mould the same into suitable shapes for burning as fuel, or I calcine in kilns or suitable furnaces. Or I sometimes take the street sweepings alone, or with the mud hereinbefore mentioned, and mix with a portion of clay and treat in like manner. The residue when burned as a fuel I crush to powder, and use as a deodoriser as described.

New utilisations of the acid residues resulting from the manufacture of chlorine. Fréderic Kuhlmann, Professor of Chemistry, Paris. March 8, 1873.—No. 847. The invention consists—(1) in the application of the residues of the manufacture of chlorine for the preparation

of lime-ide of manganese, the protoxide of manganese being superoxidised by means of ozonised air or preferably with nitric acid or nitrous gases. (2) In the application of the oxide of manganese precipitate, obtained by the action of lime on the residues of the manufacture of chlorine in metallurgy.

Improvements in the working of coal-gas tar. John Rowley, chemist, 84, Camberwell Road, Surrey. March 10, 1873.—No. 853. I take the coal-gas tar and its homologous products, either together or separate, and treat them with acids, alkalies, and chlorine. I then distil and obtain benzol, anthracen, and other products suitable for making aniline dyes.

Improvements relating to the manufacture of chlorine by means of compounds of manganese regenerated in the wet way. Walter Weldon, 29, The Cedars, Putney, Surrey. March 11, 1873.—No. 868. This invention relates to the process which is the subject of my former patents, dated respectively the 26th July, 1866; the 18th January, 1867; the 4th September, 1867; the 20th February, 1868; the 24th February, 1868, and the 10th March, 1869. It consists in economising manganese by subjecting the deposit which forms in the chloride of manganese settlers to a certain methodical washing; in economising acid and limestone by employing in the stills an excess of manganese mud, neutralising, if necessary, the last portions of the acid by lime, allowing the undissolved peroxide of manganese to settle out, and then, when it has accumulated sufficiently, employing the deposit so obtained instead of fresh manganese mud, and dissolving it completely by an excess of acid; and in certain arrangements of apparatus for effecting these objects.

NOTES AND QUERIES.

Fluorescent Spectrum.—Will some one kindly tell me what is meant by this?—Wm. John Grey.

Extraction of Lead from Sulphate.—Can any of your correspondents kindly inform me of a process for extracting lead from the sulphate arising in the manufacture of sulphuric acid?—C. H. N.

Glacial Acetic Acid and Aceton.—Will any of the readers of the Chemical News give the inquirer any information as to how the above articles are made?—R. W.

Fuller's Earth.—I understand Fuller's earth, in a powdered state, is extensively employed on the Continent for refining rosin oil. Can any of your readers inform me of the process, and where ground Fuller's earth may be had?—A. K. C.

Notes on the Utilisation of Sewage.—(From the "Report of the Main Drainage Committee for 1864," vol. 487).

2721. (To Mr. Whitehead). Does the lime process succeed in purifying the sewage?—Very far from it, and I take it that one cause is this: that the lime is not applied in the most effective manner. I think it is the same as the smoke-consuming furnaces; it depends upon the discretion of the man who puts on the coal whether it is effective or not.

2722. (To the same). Have you ever known lime to succeed in purifying the water?—I have known lime to succeed, but this evil attaches to it, that it kills the fish.

2723. And does it not also render the water unwholesome for drinking?—Quite so.

2724. Would it be unprofitable as a commercial speculation?—Certainly.

2725. You think that it would not be good for agricultural purposes?—No, as far as stock was concerned.

2726. Then would you say that the lime process was a failure?—I say that the lime process as it has been carried out in this instance was a great failure, but I think that it admits of great improvements.

2727. Previous to this lime process being used, the cattle drank the water of the stream, and now they cannot drink it and the fish die in the stream; is that so?—That is so.

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THE

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THE CHEMICAL NEWS.

Vol. XXVIII. No. 735.

ON ATOMS.

(Continued from p. 282.)

I am very glad that the two letters in last Chemical News are sufficiently calm to allow me, without feeling annoyed, to reply. I never expect very tolerant language from scientific men. I am, however, quite pleased with the words alluded to, in the sense that they seem the result of a desire to deal fairly in the matter, and to listen as well as to think. I cannot at present discuss, as I said, but I must make my meaning plainer, and do what honour my words can do to two men. The first of these is Leucippus (some people prefer Leukippos, for reasons of a limited range in the English language). I prefer to call the atomic theory of the ancients that of Leucippus, from the simple fact that he first propounded it, Many men took it up afterwards, and Lucretius went carefully into detail, but the first that published it deservedly takes the name, and I think this is too much forgotten. In modern times we have Newton, with exactly the same theory, but it would be unfair to connect him with it, because he really added nothing essential.

Dalton held the same theory of fundamental atoms or ultimate particles, as Dr. Wright has observed, and as I said in last letter; but he made an addition so decided that he marks the most important era in the history of atoms. Lucretius tells us that the primordial atoms are very different in their forms, so different that some are hooked. This shows an imperfect conception of the subject, because he did not see that smooth atoms could make all forms and qualities of bodies. Dalton had no more to aid him upon physical grounds, and he explained his idea of atom or ultimate particle from the chemical action of bodies. He had the idea of mechanical fitting. This suited the thousands of chemical phenomena so well that it has altered the whole *cosmos* to our eyes, and our theories of the constitution of compounds have had reason in them since Dalton's time. He says that a certain volume enters into combination, and it has a certain weight. That is proved to be true, and it is his, without theory. In addition, he says that the certain weight is the ultimate particle, because you find it however low you go. That may be said to be theoretical, but it is full of good analogy and sound sense. Some like to use "equivalent," but that word does not mean anything by itself, and can stand only in relation to something else. If, for example, we have oxygen and calcium alone, neither can be called an equivalent. One may say, equivalent to what? But if sodium takes the place of calcium, then it may receive the name *pro tempore*. But what is the bulk of an atom? Dalton said, substantially, I do not know; but when you have found the smallest possible piece of calcium oxide, then it may be divided into an ultimate particle of calcium and one of oxygen. His meaning is clear enough, and the use of atom in the sense used hitherto by chemists is rationally founded, whilst the use of equivalent assumes virtually the same facts, but hesitates to give them their full bearing, according to my mind. Dalton having decided, proceeded to give the relative weight of each of his ultimate particles, and arranged the subject, putting aside many fancies of Lucretius, and back to Anaximander, with a few words.

Supposing Dalton to be correct in his very common-sense view, I think we ought to call the atom, when it has attained this precise state of definition, the Daltonian atom, because we really ought never to lose an opportunity of honouring those men who have been so divinely gifted as by a thought to have illuminated all the times to come. It is as if they had a part of the power which said "Let there be light, and there was light." This of course is not used as argument,—nor indeed am I arguing at all but thinking that I am making matters clear.

Now although Dalton could say, proudly, "Show me, even in idea, a particle so small that it shall not conform to my rule," there is a certain faculty that leads us on to ask —What would happen if Dalton's atoms were split? We have no chemical experiment leading us to believe that this ever occurs amongst us, but I wish to say that a man may be a believer in Daltonian atoms, and yet believe that there are no final atoms; or he may believe in no matter existing at all. I fear I am repeating myself, but it may do no harm to let this be said in a fresh series of words. I dare say Dalton, as a far-seeing man, would have speculated as readily as any man on the divisibility of the elements, or "articles" as he sometimes called them, but he did not pretend to have gone farther.

Whilst the division of the Daltonian atom is one mode of, theoretically at least, obtaining new elements, there are other methods, and not the least beautiful; perhaps the most beautiful of all is that of the late Prof. Graham's. He gave it as a possibility that, there being one matter,—and we must suppose that to be atomic,—the differences of elementary bodies may be caused by the different rates of speed at which the atoms move; in other words, that atoms do not differ in shape, size, &c., but in primordial activity. This was the result of his examination of gases. It is a beautiful theory. We are of course obliged to give these atoms a primordial power, and this moderns agree to do along with the ancients. Even here, however, we must suppose a certain force capable of overcoming that primordial force, and, if so, the speed would be destroyed and a new element would come to our view. Who knows? perhaps it would be too active, and seek combination before we caught it; but with what would it combine? These are questions only, but they show another mode of supposing a chemistry beneath our chemistry; and our wandering exacting intellects demand that even that primordial atom, before deciding on its velocity, shall be divided, that we may see what it contains.

Another interesting view was put out by Sir William Thomson, indicating a variety of motions—not mere speed—in a primeval fluid or substance. In this case the practical Daltonian stage of matter would be a very complex body. Not having the paper before me I shall not attempt to say more; but the motion in these atoms, also, we may suppose overcomable by a superior motion, although he seemed not to think so.

In both of these latter cases, some adjustment would be requisite to fit into Dalton's weight, but still, even in them, it is needful to imagine a certain amount of matter gathered together to act. The reason of this is that we cannot picture to ourselves clearly what would be the condition of the matter before it was so gathered together. And, indeed, we become able to talk sensibly only when we begin from the atom upwards; below it is speculation. For this reason, a chemist may be a most confirmed atomist, and hold any theory of the constitution of matter. As to infinite divisibility, some have thought of it all their lives, and read much, but are glad to rest in the belief that they cannot understand why it should be true, or why it should not be true. None of the above oppose Dalton, only cause a change, which, with permission, may form the subject of a third letter. When we come to the physical theories of the present time, we find men proceeding with certainty, or almost certainty, in the belief that gases are composed of atoms. Now Dr. Wright would say that this is scarcely correct, because "molecule" is the word used. I know it, but I have given my own interpretation of the word atom, or, rather, that of chemists taking Dalton's view. I call one "the smallest undivided particle;" that of the older and of many later physicists is "the smallest indivisible particle." In considering the constitution of gases, our

physicists speak of the movement of undivided particles, that is, particles which they have no good reason to consider as existing divided in the gas. The molecular mobility of gases, or of elementary particles of gases, is not put a stop to by combination with another gas, as oxygen with nitrogen, and if we call one an atom, and the other a molecule, we should probably speak more according to our knowledge. Atom, used as an undivided molecule, suits chemists well, because they can say, as now, an atom of a complicate substance, say albumen, knowing that in that case, although physically divisible into several elements, the removal of any one destroys the identity of that which can exist only as a group.

I have not opposed Dr. Wright by speaking against his view, but I may say that I see no weakening of the Daltonian atom in any theory of motion among the particles; Dalton's theory is wide enough to hold it all. When bodies are isomeric, we naturally look either to a difference in the arrangement of the particles, or a motion amongst them. Dalton's theory is well enough prepared for the first; I do not know that he thought of the second, but, had he done so, he would not have required to change either weight, number, or size of any of the component parts.

I shall only add that the quotation from Watts's magnificent and valuable "Dictionary" does not please me; and, first, the words "some use it in its strict Daltonian materialistic sense." In what other sense can we use it except a materialistic? Even Boscovich would use it in its materialistic sense. The immaterial, if it is desired, would certainly be something below the atom in any use of the word known to me. Again, "Others use it in an abstract sense, only to express the smallest indivisible combining proportion of a body." Why, that is Dalton's meaning (leaving out the word abstract, which is not in harmony with the other clause), so that he includes both. Then it is added, "and consider the proportional number of a body as an ultimate or unexplained property belonging to it." I feel sure that Dalton considered it both ultimate and unexplained. I do not understand *greatest common divisor system*, except in a sense which brings us also to Dalton's atom; his system is, in fact, so wide that I do not see any facts that shut it out, but I have tried to see, and, in doing so, the subject beyond has become a mystery. If, however, Dr. Wright really thinks that the use of the word atom confuses the student's mind, that certainly is a good reason for not using it, and better for a teacher than any facts which came from the beautiful researches of Joule, of Clausius, of Clerk-Maxwell, Sir William Thomson, and Graham. I think it better, however, before changing, for chemists to see what these researches will produce; to me they are developments of Dalton: but the subject in abstract is very difficult, and it will be long before we all think alike, so I give only a few scraps of the thoughts of one who can see but a little way at best, being only an

ATOM.

ON THE

SENSITIVENESS OF BROMIDE OF SILVER TO THE SO-CALLED CHEMICALLY INACTIVE COLOURS.

By Prof. HERMANN VOGEL.

IT is known that certain colours—such as red, yellow, and green—act very slightly, or not at all, upon a photographic film. This circumstance not only puts a difficulty in the way of the photographer of colours (oil paintings, &c.) but is also a stumbling block to the portrait photographer, who has to depict not only coloured drapery, but yellowish complexions, blonde hair, and red cheeks. High lights which are tinged with yellow appear dark in photography, and shadows when tinged with blue are reproduced lighter than they should be, the only way of subsequently mending matters being by means of retouching upon the negative.

This abnormal sensitiveness for colours possessed by photographic plates is more conspicuous when the lines of the spectrum are rendered by photography, when beyond the violet a vigorous action is apparent, while in the visual spectrum—according to Schultz-Sellac—the action is not perceived farther than line E in green. Recent experiments with bromide of silver have, however, shown me that the sensitiveness of the body not only reaches much further, but that if certain accelerating substances (or "preservatives," as they are sometimes called) are employed the action goes as far as red—that is to say, reaches a point where hitherto it has been to photography as the darkest night.

I recently received from England some Wortley dry collodio-bromide plates. These I exposed to the spectrum, and found to my astonishment that they were more sensitive at the line E in green than in light blue at the line F. Here, therefore, I obtained a result in regard to sensitiveness in opposition to experiences hitherto recorded, the film being more sensitive for colour supposed to have little chemical activity than for a vigorous chemical tint. It is true not all the Wortley plates gave this result, some of them giving it but faintly, and others not at all. At first I believed the same to be due to alkaline development, and said as much, but found afterwards that an iron developer gave similar results. This circumstance caused me to undertake a closer investigation of the sensitiveness of bromide of silver in connection with the spectrum colours.

My apparatus I prepared with the aid of a photographic camera fitted with a Steinheil lens, and this was directed against the prism of a spectroscope. The slit was 0·25 millimetres wide. The sun's rays were thrown upon this with the aid of a Foucault heliostat, which my friend Dr. Zenker placed at my disposal; the spectrum image from D to G measured 35 millimetres. For comparative experiment I chose the time from 11 a.m. to 5 p.m., with a sky perfectly free from cloud—a thing rather difficult to obtain at this time of the year. The period of exposure lasted, as a rule, about ten minutes. After exposure, the plates were developed by means of sulphate of iron. At the very first experiment I found that the sensitiveness of the bromide of silver stretched to a point much further than Dr. Schultz-Sellac has shown. This gentleman only obtained an action of the ultra-violet near line F in blue. In my experiments the sensitiveness in every case was shown to extend beyond line F, more or less far according to the transparency of the atmosphere.

I employed the bromide of silver in two forms: that is to say, in a moist state, with nitrate of silver solution attached to it, and, again, as dry plates, produced by washing off the silver solution and drying. They acted differently. It was found that dry bromide of silver has a much greater sensitiveness for colours than bromide of silver moistened with silver solution. The latter, on development with an *acid* developer, showed sensitiveness to midway between D and E—near to the yellow, therefore; while the dry film gave a sensitiveness for 2 millimetres beyond, into the orange.

The nature of the impression on the two plates was also different. In the wet bromide of silver an exceedingly vigorous action was observed between G and F (in indigo and blue). At F, however, it vanished rapidly, and only a slight action was perceptible beyond E. The dry plate showed a much weaker action in the blue than the other, but the impression went off more gradually, and reached, as already stated, as far as D.

Dry bromide of silver is therefore more sensitive for the less refrangible, and wet bromide of silver for the highly refrangible, blue rays of the visible spectrum.

For ordinary photographic plates, a solution of silver is a vigorous accelerator—that is to say, it increases the sensitiveness, because it combines with the iodine or

bromine set free on exposure. When this action takes place principally in blue, it may be explained that the blue rays are more vigorously absorbed by the wet film than the others. I was aware, last summer, when experimenting with iodide of silver, that a body only then enhances the sensitiveness when it is not only capable of combining chemically with free iodine, but absorbs also the chemically active rays. For instance, dry pyrogallic acid, which combines with iodine, makes an excellent sensitiser, but in solution is of no avail, as it allows the chemical rays to go through unimpeded. Optical and chemical action must be combined in a body in order to be an accelerator.

As already remarked, the sensitiveness of the dry bromide plate gradually diminishes from blue to red. Of the phenomenon which I observed in so marked a degree upon most of the English bromide of silver plates—viz., a lack of sensitiveness from violet to blue, and an increase from blue to green—I observed nothing when working with bromide of silver plates prepared by myself. The explanation just referred to, of the action of nitrate of silver solution upon bromide of silver, caused me to think that the English bromide of silver plates contained a body of some kind which absorbed the green in a higher degree than the blue. So far as is known a yellowish pigment is sometimes added for the accredited purpose of checking the chemical blue rays, but it is possible that the body here employed does not absorb the blue rays, but allow them to pass, only hindering them in some degree.

The Wortley plates contain nitrate of uranium, gum, gallic acid, besides the yellow colouring matter. To ascertain whether this coating exerts any action, I washed one of the plates with alcohol and water, and obtained in that way a plate which did not show any increased sensitiveness in the green. I next essayed to impregnate bromide of silver with a substance especially capable of absorbing the yellow rays, and which combines with free bromine and iodine, in the hope by this means of improving the sensitiveness of the plate for yellow rays. I chose coralline for the purpose which Professor Liebermann kindly placed at my disposal. A very dilute solution examined under the spectroscope gives an absorption-band between D and E, and stronger solutions cause the band to be increased beyond D; on the other hand, blue near F is allowed to pass to an appreciable extent.

I dissolved the coralline in alcohol, and added to it some of my bromised collodion, so that it became coloured of a vigorous red. With this collodion some bromide of silver dry plates were prepared, which were tinted of a reddish colour, and these, submitted to the action of the spectrum, confirmed my previous speculations; the plates showed themselves to be sensitive in the indigo portion of the spectrum, and the sensitiveness diminished towards light blue, became weak at F, then increased, and appeared in yellow as vigorous almost as in indigo. I had therefore discovered a method of producing bromide of silver plates which could be acted upon quite as vigorously by a colour held to be bereft of active chemical action—as, for instance, yellow—as by a colour such as indigo, which hitherto had been considered to exert the greatest chemical action.

After these experiments, I was led to hope than any other body capable of combining with bromine, and which would absorb red vigorously, would also heighten the sensitiveness of bromide of silver for the red rays. Such a substance I found among the green aniline colours. These absorbed vigorously the red rays midway between D and C; the absorption stretched with greater concentration farther towards D,—yellow, green, and blue, passing through almost intact. A collodion tinted with this aniline green was found, indeed, to be sensitive into the red. The sensitiveness diminished from indigo to yellow, and then increased, and, on that spot where the absorption-band had been remarked, there the film was most sensitive to red.

From these experiments we may conclude, I think, with tolerable accuracy, that it is possible to render bromide of silver sensitive to any desired colour, improving its sensitiveness for certain colours. It is only necessary to add to the bromide of silver a suitable body which absorbs one chosen colour, but not the others. Perhaps we shall get so far as to photograph the ultra-red spectrum, just as we have depicted in the camera the ultra-violet. The till-now supposed photographic inactivity of certain colours, which is so often a stumbling-block, would then be obviated. In how far the results are of practical importance the following experiment will show:—A blue band upon a yellow ground was photographed. With an ordinary iodide of silver collodion plate, I obtained a white band upon a black ground. With a bromide of silver coralline plate, upon which blue and yellow acted with equal power, nothing could be obtained, I foresaw, and for this reason, I put in front of the lens a yellow glass plate, which absorbed the blue light, and allowed the yellow rays to pass through unheeded; and then I was enabled to obtain, after a sufficiently long exposure, a dark band upon a light ground.

The matter is, however, not simply a technical one, but also of interest from a scientific point of view. Until now we believed that the haloid salts of silver could only be chemically altered by rays which they absorb in to a notable degree, and the value of "accelerators" or "preservatives" was scarcely credited (Schultz-Sellac).

My experiments teach that in the sensitiveness of photographic plates it is not only the optical absorption power of the sensitive silver salts, but also the optical absorption power of substances mixed with them, that exercises an important influence in the matter.—*The Photographic News.*

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 312).

Lecture VII.

On the Energy of Heat, with especial reference to the Measurement and Utilisation of it.

The energy of heat has, in one form or other, attracted more notice than that of any of the other imponderables with which this course of Cantor Lectures has to deal. Various explanations of the cause of heat being possessed of energy have been given, but it was not until the closing years of the last century that views on this question were first enunciated, which have since borne such good fruit. Count Rumford, in 1798, by an experiment in the boring of cannon in the arsenal at Munich, and Sir Humphrey Davy, in 1799, by the liquefaction of two pieces of ice by the friction of each on the other, laid the foundation of that explanation which has been so successfully generalised, and which even now is hopefully pursued.

The first question that presents itself to us is, "What is heat?" And in order to present the modes suggested for measuring it which are diagramically expressed on the wall, it will be needful to make some preliminary statements. In the general table of energies the sources of heat are represented as the sun and fuel. That term fuel might with very good reason have been omitted, for the one source of heat is the sun; fuel is a secondary source, having its primary in the sun. Heat obtained from the sun and the circumstances under which it is obtained are foreign to the subject of this lecture. Heat obtained from fuel, and also from the sun, is kinetic, or capable of producing motion when it is radiant, or passing from place to place; and it is potential, or stored up,

* The Cantor Lectures, delivered before the Society of Arts.

when it is absorbed. Now it was absorbed in those primeval times when there was an immense mass of vegetation on the face of the globe; that vegetation absorbed the heat. In these primeval forests it has been preserved, and in such fuel as coal it is restored. In being so restored or returned, that is given back to the earth which was absorbed perhaps before the creation of man. These buried forests are now a-glow with light, and heat, and vigour—unmistakable types of resurrection from a grave. Let us turn to that received from the sun, and refer to the diagram of the spectrum which many of you saw last week, and consider how that diagram aids in illustrating the question of heat. On Monday last an endeavour was made to explain how it was related to the phenomena and energies of light, and incidentally to the phenomena and energies of chemical affinity. One portion is related to the energy of light, properly so-called; another portion is related to the energy of affinity, properly so-called; and in this portion, which is perfectly obscure, and which escaped notice until recent years,—in this which is invisible to the human eye, although it may be visible to the eyes of other animals, lies that which we call solar heat. You observe that to the spectators' left-hand of the portion marked with the usual prismatic colours there is a shade of red extended to a length equal at least to that marked with such decided colouring. It is not far from the truth to say that in this lies all the heat from which we obtain our stock of motion. It may be desirable to explain how we know that the heat lies there, and why the diagram is there drawn, and extending to such a distance from the visible portion of the spectrum, and that in such portion lies the greatest amount of heat. It is done in this way:—We take a little instrument called a line thermopile, composed of a number of strips of metal laid edge to edge, and soldered at the alternate ends. The two metals are usually antimony and bismuth. The pile is in the form of a straight line, because it is to be used for determining the heat at a particular portion or line across the spectrum.

Thermometers for heat purposes may be said to be useless, and, perhaps, before going further, it may be well to state why they are so. A thermometer is an instrument which, by the expansion of a fluid, as air, or a liquid, as alcohol, mercury, &c., or by any other means, tells us the difference in temperature between two bodies. If a thermometer be placed in water, it would tell us how much the temperature of the water is above the freezing-point, or how much below the boiling-point. But freezing- and boiling-points are neither of them standard points. There is heat far below the freezing-point, and there is heat still higher than the boiling-point; and indeed there is no approachable zero from which to commence the graduations of a thermometer. We want, too, another thing, not relative heat but absolute heat. Another means for obtaining records of heat is by the use of the thermopile and a galvanometer. This galvanometer is connected with the thermopile, and the speck upon the screen is that to which we have to look. If two short thin wires, one silver and the other copper, be taken, one wire attached to one end of that round the galvonometer, and the other to the other end, questions in relation to heat, and electrical phenomena in connection with it, may be made clear. If the free ends of the silver and copper wire be placed in contact and held between a finger and thumb, or placed near a lamp-flame, the speck immediately moves, and travels over a large space. No thermometer is so delicate or sensitive to heat as this combination of instruments. The heat which in a thermometer would be employed in expanding the liquid is in this case converted into an electrical current which affects the galvanometer. Heat in the one case is measured by the expansion of a liquid, in the other by being converted into electricity, and the electricity is measured, as explained in a previous lecture, by the galvanometer. The speck is now steady, but on taking hold of the junction of the wires the speck moves in consequence of the simple touch of a finger. If the junction be once waved near the flame of a lamp, the speck moves directly—evidently there is a real and measurable energy in the heat which has passed. It should be remembered that this galvanometer requires quantity of electricity, and not what is called intensity. That motion, therefore, by being properly measured, enables us to get, inferentially, at the quantity of heat. The measurement of heat by differences of temperature is called "thermometry." The measuring of an absolute quantity of heat is called "calorimetry."

These metals thus indicating heat by the conversion of it into electricity are applied here in a line, and if this apparatus is placed in front of a real spectrum, of which that on the wall is a pictorial diagram, and moved gradually along by means of a fine-threaded screw, the line thermopile passes into successive portions of the spectrum, and according to the amount of heat in each portion, so the galvanometer deviates. If, therefore, the galvanometer at one portion is sent further aside than at another, we know it is owing to a larger quantity of heat being converted into electricity. Such an arrangement was carried out, and the largest amount of heat was found to be where that high mountain is marked on the drawing. This much must at present suffice for showing how to determine and measure the quantity of heat.

Now let the consideration be how this heat is converted into motion. Motion, we know, produces heat, but here the converse question is presented — heat producing motion. If we can show that heat produces motion, and if we know that motion produces heat, those two are mutually interchangeable. That no motion can take place without the development or absorption of heat may be made manifest by an experiment. Here is a thermopile, rather more delicate than the one hitherto used. Here is an air-pump, connected with which are two copper vessels separable by a tap. If, now, the air be exhausted from one of these vessels, the one nearest to the air-pump, it then becomes empty, and if the thermopile be caused to touch the other vessel, or to touch this one, which is empty, and the speck of the galvanometer is stationary; then, when the tap that separates the two is opened, air rushes from one into the other, and the galvanometer speck indicates a change in the heat relationships of the two vessels. These changing heat relationships result whenever action takes place. If a thermopile having a larger surface, intended for the purpose of investigating very delicate changes of temperature, be attached to a condenser which serves to increase the surface and so to magnify the result, it would be found that by merely touching one portion the speck of the galvanometer moves. Now, if a fan be caused to act in front of and upon the thermopile, the impression would be that we should withdraw heat. The withdrawal of heat may be produced by the blast of air, but this air strking on the thermopile causes the spot of the galvanometer to move in the direction indicating an increase of heat. The question is, whence comes that increase of heat? The answer is, that heat comes from my arm, and is produced by muscular energy being converted into mechanical power, which is then transformed to heat, which is changed into electricity. In this case the energy passes direct from my arm through the fan, and propels a current of air against the thermopile. If, however, the draught of air upon the thermopile, instead of being direct from my hand had been treated in this way,—if a close vessel had been taken, and by means of a condensing syringe, air had been forced into it, and allowed to remain for a few minutes, and then jetted against the thermopile in the same way as the air from the fan—we should find, after the first impact of air, that cold and not heat had been produced. Therefore the one blast blows hot, and the other blast blows cold. Thus, Æsop's fable of the man and the satyr appears to be realised. Much confusion has arisen from the use of the word cold, as though it was something distinct from heat.

"Cold" is only a condensation of the phrase "decrease of heat." Conflicting views would sometimes be harmonised were this word disused, and the word "heat" employed with a proper prefix.

There is a very good reason to be given for these results. The case of a blast producing decrease of heat may be illustrated thus :—In this iron bottle there is some condensed carbonic acid gas, which is under a pressure of about 700 lbs. on the square-inch. Now, it might be expected that as the blast from the fan produced heat, so the blast from this bottle of condensed gas would also. A jet of this condensed gas is now directed to the thermopile ; the reflected light of the galvanometer by its motion indicates that the currrent has produced cold. It certainly appears remarkable that in the case of one blast heat is manifested, and in the other cold is produced. The explanation is this :—In neither case can the air be put into motion, except by the expenditure of heat. In the case of a fan the heat is at once expended in causing a blast of air, but in the other case the heat is expended in the previous act of condensation. When this condensing syringe has been used for two or three strokes, the cylinder of the syringe has become hot. The process of heat radiation is continuous. As soon as that bottle was filled, the heat accumulated in the work of condensation began to radiate. In other words, the muscular energy, which condensed the gas into the bottle, was dissipated in the form of heat. The contents of the bottle require an expenditure of that which may be represented by as much heat to get out of the bottle as they required to put them in ; therefore this heat must be drawn from some source or other, and the first supplies are drawn from the contents of that which was in the bottle. The paradoxical and apparently contradictory phenomena are, however, reconcilable in a most instructive manner. In the case of the fan the blast carries the muscular energy converted into heat direct to the thermopile. In the case of the bottle this heat has been dissipated by radiation.

Let us now consider and describe how Mr. Joule obtained that which has become the basis of our calculations, and the arithmetical measurement of heat, namely, 772 foot-pounds as the mechanical equivalent of the amount of heat required to raise 1 lb. of water through 1° F., or 1390 foot-pounds for raising the same quantity of water through 1° C.

His experiments extended over about seven years, and the first apparatus used was the one shown in this diagram. There is a small vertical shaft capable of being rapidly turned by a handle : across or through the shaft is a short glass tube, in which were introduced a number of bars of wrought-iron. These were covered with oiled paper, so separating them electrically one from the other. The bundle was wrapped round with copper wire, and then inserted into the glass tube, which was closed at one end with a cork, and capable of being closed at the other. That glass tube was coated with tin-foil, so that in fact the tube was very like what is called a Leyden jar. It had an electrical coating inside and out, the only peculiarity being that a slit was cut along the coating on the outside of the vessel to prevent electrical induction. The tin-foil was then covered by strips of wood parallel to the tube, and bound all over with silk. The ends were corked, and also covered with oiled silk, so as to close it thoroughly. From the inside of the tube two wires passed down and dipped into two mercury cups, which were connected with a galvanometer, so that currents of electricity, if any were produced in the interior metal bars, would be manifested by the galvanometer. On each side of this short glass tube were fixed two arms of wrought-iron, bent in the form of a horse-shoe, and as nearly in contact with the ends of the glass as possible. This wrought-iron horse-shoe had a coil of copper wire round it, and by the usual means it could be converted into an electro-magnet. A certain weight of water was put into the short glass tube along with the bars, and having rotated the instrument for a quarter of an hour, the temperature of the water when examined was found to be hotter than before. The galvanometer being observed it was known what electricity had passed, and this, combined with the change that had taken place in the temperature of the water after fifteen minutes rotation of the shaft, at the rate of six hundred rotations per minute, sufficed for determining the amount of electricity converted into heat. Thus, approximate data were obtained on which to found other experiments. Such experiments were made and re-made, they failed, and were again renewed ; and to note how Mr. Joule overcame one difficulty after another, until he succeeded, furnishes a beautiful example of perseverance. Sometimes where he expected to find a substance had gained heat, he found, on the contrary, it had lost. Such anomalies, however, were afterwards completely accounted for.

Research in science claims the exercise of much ingenuity under unexpected and baffling conditions. The perplexity just described became an element in success. Mr. Jonle availed himself of the process of "interpolation," and so adopted what proved of great assistance in future experiments. What has been described was the earlier of many processes. Next, he found it needful to measure the energy exerted upon the handles, because if in this vessel a quantity of heat had been generated which produced an observed increase of temperature in the water, it was desirable to know what was the value of the mechanical energy which had caused that heat to be so generated. If motion be given by the hand only, there is no means of measuring that value. The earlier object was to see if heat could be obtained ; then the next object was to measure the heat obtained, and also to measure the mechanical energy by which it had been obtained. The apparatus now assumed this form. He gave up the electrical process, and began to take a vessel, similar to the one shown in this diagram, which had brass plates in it, and brass bars fixed to the inside of the vessel, and running across, so that paddles could rotate between the bars. The vessel was filled with water, and therefore, when the paddles rotated, the fixed bars stopped the whirl of the water, and heat was developed. The sea, as those who are accustomed to bathe know very well, is warmer on a windy day than on a calm day, simply because the motion of the water caused by the wind is converted into that motion of the molecules of the water which we call heat. So in the experiments with this apparatus, the motion of the water in the vessel is converted into the motion called heat. Of course all possible means were adopted to prevent heat passing by radiation from the exterior of the vessel. Hence the vessel was enclosed in another, and that again in another. The contrivances for ascertaining a measure of the mechanical effort made to keep the paddles rotating at a uniform rate were very simple.

The little vertical shaft on which the paddles were fixed was prolonged upwards, being divided across and re-connected in line by a piece of vulcanite, which, in common phraseology, would be called a non-conductor of heat. Wound round the upper part of this shaft were two cords, the ends of which passed over two pulleys on opposite sides. To these cords were fixed weights, by the descent of which motion could be given to the paddles. The cords were two in number, and on opposite sides, in order to obviate as far as possible the heating effect of rubbing friction on the shaft journals. With this apparatus, and others constructed upon similar principles, a series of experiments enabled him to arrive at certain definite conclusions.

In a research of this kind, made with apparatus contrived as new thoughts and new experiments suggested, it was not to be expected that the tabulated results should speak with one consenting voice. They did, however, seem to proclaim this—that the mechanical equivalent of heat competent to give an increase of temperature of 1° Fahrenheit to 1 lb. of water, was between 500 and 800 foot pounds. Detecting and

eliminating those elements which seemed to affect the accuracy of the result, he was enabled at last to come to this conclusion, that 772 lbs. was the exact number which was the mechanical measure, or, as it is commonly called, the mechanical equivalent of heat. That means this—he found how much a known quantity of water was raised in temperature by a recorded mechanical exertion, and he deduced the measure of that exertion needful to raise 1 lb of water 1° on Fahrenheit's thermometer. Thus he found that that heat, applied to raise weights, would lift 772 lbs. through one foot; that is, if you had 772 lbs. weights here, and lifted them a foot high, it would be the same thing exactly as applying the same force to 1 lb. of water, and raising the temperature 1° Fahrenheit.

There is a table written out mathematically, by means of which the 772 lbs. are deduced. Mr. Joule having made these experiments, others followed, and we have a table showing the means used, air, friction, steam, Daniell's battery, electro-magnetism, &c.; also the names of the experimentalists, and the mechanical equivalent of heat, as determined by them. Although the results differ from Mr. Joule's 772 lbs., yet his figures are now generally adopted.

The title of this lecture includes the words measurement and utilisation. The utilisation of heat is so important a commercial as well as scientific question, that there are one or two matters bearing upon it which may be worth present attention and much future thought from all. That we do not obtain in a steam-engine more than a quarter of the heat we expend in the furnace is now generally recognised. There is a table here, based upon Mr. Joule's calculations, which gives the number of horse-power—a technical term, meaning 33,000 units of work, which could be obtained by utilising the heat required for passing nine pounds of ice through its physical and chemical changes. If we have 9 lbs. weight of ice, and attempt to melt and convert them into liquid, a certain amount of heat is absorbed or rendered "latent," as it is called. At any rate there is a quantity of heat that does not show itself upon the thermometer. Then, after it is converted to water, if we gradually raise the temperature to 212°, there is another large quantity of heat rendered "latent" in the conversion of this water into vapour, and if we then convert that vapour which comes from the water into its elemental gases, viz., oxygen and hydrogen, another large quantity of heat is absorbed or rendered "latent." Now take that process backwards; assume we can take this 9 lbs. of oxygen and hydrogen and re-convert them back again into ice, and that it was in our power to use the heat which had been given off, then we get the quantity shown in the table. If we burn a quantity of hydrogen in oxygen it is converted into water; if one part of hydrogen and eight parts of oxygen are combined by an electric spark or other means, and converted into water at 212°, a number of units of heat equal to 1451 horse-power are obtained. If, then we pass it still further into the form of water at 32° we should obtain 38 horse-power more; and if we then pass it from the form of water into the form of ice, we should obtain 30 horse-power. Therefore, if in obtaining 9 lbs. of ice from its primeval elements, viz., 1 lb. of hydrogen and 8 lbs. of oxygen, we could utilise as a mechanical agent all the heat set free, then from the data given we see that there would be obtained 1519 horse-power of work. But we cannot obtain this. What becomes of the heat, where it goes, and why we cannot contrive to utilise it, are inquiries which yet perplex scientific students. Various surmises have been made, but none of them have been accepted, except as the vague guesses of an unsolved riddle, the best of which are taken, though there remains a lurking feeling that none of them are right.

There is another table bearing on this question, viz., the advantage of using steam at a higher pressure than what is called low-pressure steam. If we take water at 33°, that is just above the temperature of ice, and that be warmed until it attains the temperature 213°, it would occupy a bulk 1669 times as large as it was in the form of water. There is a relation between the pressures and temperatures which must be maintained, in order to preserve the whole of the water in the form of steam. These relations are expressed in the first two columns in the following table. The third column expresses the resulting volume of steam. The fourth column is the product of the pressure and the volume, and, therefore, represents the mechanical value of our unit of water. How much and at what rate this value or power increases with an increase of heat, and a correspondent increase of pressure, may be known by considering the figures in this fourth column. These figures represent the advantage of using steam at high pressures, and, therefore, high temperatures:

STEAM FROM WATER.

Pressures. lbs.	Temperatures. Deg. F.	Volumes.	Pressure multiplied by volume.
15	39	1	
15	213	1669	25,035
25	240	1042	26,050
35	260	765	26,775
45	275	608	27,360
55	288	506	27,830
65	299	434	28,210
75	308	381	28,575
85	317	340	28,900
95	325	307	29,165

The reason why we cannot work steam at some of these very high temperatures is this, that when we superheat it, we thereby prevent any of it being converted into vapour, and if it is not so converted into vapour we have no means of lubricating the faces of our slide valves, and the consequence is, the metals being heated, they soften, then scratch and tear each other's faces, and the engine is soon destroyed. As soon as we can get slide-valves made of some material which will bear this higher temperature without abrasion or scratching, then, probably, we shall be able to work superheated steam economically.

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 18, 1873.

Dr. ODLING, F.R.S., President, in the Chair.

THE names of the visitors having been announced, and the minutes of the preceding meeting read and confirmed, Mr. Robert Williamson was formally admitted a Fellow of the Society.

The names read for the first time were those of Messrs. Howard Barrett, Thomas Pemberton Wiltshire, George Whewell, and John Young.

For the third time—Messrs. Edward H. Davies, Sydney Trivick, John Smyth, M.A., Edmund Richard Southby, Edward Daniel Stone, John Sutherland, Carl Schörlemmer, F.R.S., and John Clement Souter, who were then ballotted for and duly elected.

The PRESIDENT said the Fellows would doubtless remember a paper read before the Society, "On the Dioxides of Calcium and Strontium," by Sir J. Conroy; he had received a letter from Dr. E. Schöne, of Moscow, in which he pointed out that, as early as 1866, he had published a description of these compounds in the *Bulletin de la Societe Imperiale des Naturalistes de Moscou*, and which has also appeared in the *Ber. d. Deutsch. Chem. Ges.*, vi., 1172. Dr. Odling had also received another reclamation, from Mr. Horsley, with respect to Mr. Donkin's pro-

cess for determining the amount of nitrates in water, recently communicated to the Society, but he employs pyrogallic acid (CHEMICAL NEWS, vol. 28, p. 254) instead of phenol, and only as a qualitative test, not as a quantitative method.

The first paper, "*On the Preparation of Standard Trial-Plates to be Used in Verifying the Composition of the Coinage*," was read by the author, Mr. W. CHANDLER ROBERTS, Chemist to the Royal Mint. After sketching the history of the composition of the alloy employed for the English gold and silver coins, the author gave a table of the composition of the five gold and silver trial-plates since 1660, showing that they sometimes varied considerably from the standard of 916·66 for gold and 925·0 for silver. The alloy in the last gold trial-plate, that of 1829, consisted of equal parts of copper and silver, but since 1837 the coin itself has been alloyed with copper alone. The new trial-plate has been prepared by melting together pure gold and copper, the purity of which was guaranteed by its high electric conductivity; of course, repeated meltings were necessary before the proportions of the metals had been correctly adjusted. Assays of pieces taken from various parts of the plate showed that it was homogeneous. Much difficulty, however, was experienced in preparing the silver trial-plate, owing to the tendency which the alloy, when cast into bars, has to be richer in silver in the interior than on the exterior, as shown by the experiments of Levol. In order to overcome this, it was necessary to resort to an artifice—casting the metal in the form of a hollow cylinder, which was then cut open and rolled; this did not succeed, the upper and lower portions of the casting possessing different compositions. 1000 ozs. of standard silver were therefore cast into a plate 30 centims. long, 25 wide, and 5 thick, the surface to the depth of 4 m.m. being subsequently planed off. This was then rolled out, and portions of metal removed from all parts of the sheet for assay. By this means it was found that a comparatively small portion along one edge of the plate was homogeneous and to have the required composition; the rest of the sheet was removed, and this portion is reserved as the standard trial-plate. Owing to the impossibility of obtaining plates of alloys which shall be absolutely homogeneous, the author suggested to the Lords of the Treasury to supplement the standard plates by plates of perfectly pure gold and silver. The gold plate was precipitated from more than 100 gallons of solution of auric chloride by means of oxalic acid, and the silver plate was prepared by Stas's process of reducing an ammoniacal solution of argentic nitrate by ammoniacal cuprous sulphite. [The trial-plates were exhibited, as also a magnificent specimen of crystallised gold.]

The PRESIDENT having thanked the author for his communication, Mr. H. W. FIELD said his own observations quite agreed with those of Mr. Roberts. In 1852, under Sir John Herschel, the use of fine gold as a comparison for the standard was introduced; for this purpose pure gold was obtained, and from that time the coin had been made according to the standard of 916·66, and not according to the trial-plate of 1829, which was only 915·5. He had compared some of the earlier coins with the plates, and had found a great variation from the standard.

Mr. RIDSDALE said he had in his custody some of the earliest trial-plates, including that of 1447, in Edward IV.'s reign, of 99·48; on Oct. 16, 1660, this was changed for the new standard trial-plate of 916·66 He had not examined all the trial-plates.

Mr. H. J. CHANEY, of the Standards Department, said they were greatly indebted to Mr. Roberts for the care he had taken in preparing the new trial-plates, and desired to thank him on behalf of the Warden of the Standards.

Dr. BOYCOTT remarked that the gold alloyed with silver and copper was harder and wore much better than that alloyed with copper alone. He could confirm Mr. Roberts's remarks on the irregularity in composition of silver bars; in Mexican dollars, the bars for which were cast just the width of the coin, the centre of the coin varied considerably from the edges corresponding to the edge of the bar; in crown pieces, too, the centre usually contained more silver than the edges.

Mr. MAKINS was surprised to find that Mr. Roberts had such difficulty in obtaining silver bars of uniform composition. Levol's experiments were made on small quantities cast in iron moulds. The speaker had found that bars cast in very hot sand and slowly cooled were very uniform in composition throughout, and those cast in red-hot iron moulds were almost as good.

Mr. ROBERTS replied that he had tried casting at all temperatures; he had surrounded the moulds with ice, and he had used them red-hot, but he had not been so fortunate as Dr. Boycott, for he had never succeeded in obtaining homogeneous bars by this means.

Mr. CHANEY observed that the Warden of the Standards had been in communication with both Stas and Peligot on the subject, and they admitted that it was impossible to produce bars of these alloys which were perfectly homogeneous.

A communication, entitled "*Researches on the Action of the Couple on Organic Bodies*" (Part IV., "*On Iodide of Allyl*"), by J. H. GLADSTONE, Ph.D., F.R.S., and A. TRIBE, F.C.S., was read by the former. The action of the dry couple on allyl iodide at 100° gave rise to diallyl and a non-volatile resin, $n(C_3H_4)$, apparently isomeric with allylen; no gas was evolved, neither was any organic zinc compound produced, the principal reaction being—

$$2C_3H_5I + Zn = ZnI_2 + \begin{matrix} C_3H_5 \\ C_3H_5 \end{matrix}$$

The production of the polymeride of allylen the authors attribute to the zinc oxide unavoidably present in the couple. Unwilling to relinquish the hope of obtaining zinc allyl, they tried the action of the couple on the iodide in the presence of ether, but the result was substantially the same, no zinc allyl appearing to be produced. The action of the iodide on the couple moistened with water proceeds rapidly, giving rise to propylen, the reaction being $C_3H_5I + H_2O + Zn = ZnIHO + C_3H_6$. The couple acts so violently on allyl iodide in presence of absolute alcohol that the experiment was modified by substituting for it granulated zinc, and even then the action becomes unmanageable unless the apparatus is kept cool. Alcohol of sp. gr. 0·805 acts more slowly, owing to the retarding influence of the water. The gas evolved is pure propylen, and the reaction thus affords an easy method for preparing that hydrocarbon; for this purpose, some granulated zinc and absolute alcohol are placed in a flask furnished with a delivery-tube and thistle-funnel, allyl iodide being gradually added as the gas is required—

$$C_3H_5I + C_2H_6O + Zn = Zn\begin{matrix} C_2H_5O \\ I \end{matrix} + C_3H_6.$$

Dr. ODLING, while thanking the authors for their interesting communication, enquired whether the action of the couple continued as long as any zinc remained.

Dr. GLADSTONE replied that it did, although the action became slower as the amount of zinc diminished.

Dr. WRIGHT said he felt some interest in the fact that the allylen was polymerised at the instant of its formation, and not given off as such; a similar reaction took place in the decomposition of sulphovinic acid, where polymerides of ethylen of high boiling-point were simultaneously produced. He might also mention that some time ago a process was patented for the preparation of aniline from nitro-benzol by means of a copper-iron couple prepared by treating the iron with a dilute solution of cupric sulphate.

Dr. R. SCHENCK read a paper "*On Tetranickelous Phosphide*." On pouring a solution of nickelous chloride into a boiling solution of potassic hydrate to which phosphorus has been added, a brown precipitate is immediately formed, which is soluble in dilute acids, but in a few minutes a black substance, insoluble in acids, begins to be formed; this, after purification, was analysed, and found to correspond pretty nearly with the formula for an oxyphosphide

of nickel, $Ni_4P_2O_4$. The experiment was accordingly modified by previously adding to the solution of nickelous chloride enough tartaric acid to prevent the precipitation of nickelous hydrate by the potash; the product, on analysis, was then found to have the composition Ni_4P_2. When ignited in a current of hydrogen, the black compound changed its colour to dark grey, contracted in volume, and became much harder. The phosphide dissolves very slowly in dilute hydrochloric acid, readily in dilute nitric acid. In aqua regia it dissolves sometimes slowly sometimes quickly, as also in sulphuric acid. It is not magnetic.

The PRESIDENT thanked the author for his communication on this little-studied class of bodies. The tetra-nickelous diphosphide belonged to a class of compounds analogous to the sub-salts of copper in which the metal acted as a quasi-monad; there was also a similar insoluble subsulphide of nickel.

Dr. WRIGHT remarked that the action of carbon monoxide on the oxides of iron, cobalt, and nickel, gave rise to suboxides of these metals, having the compositions Fe_2O, Ni_2O, Co_2O, in which the metals appeared univalent.

Dr. SCHENCK said the action of phosphoretted hydrogen on the metals, kept in solution by tartaric acid, produced phosphides much richer in phosphorus than those obtained from the hydrates, but he had not yet examined them.

A note, "*On Ferrous Anhydrosulphate*," was read by the author, Mr. T. BOLAS. On mixing a cold saturated solution of ferrous sulphate with nine times its volume of concentrated sulphuric acid, a white crystalline powder is deposited as the mixture cools, or immediately if the solution of iron is supersaturated. When microscopically examined, this powder is seen to consist of minute prismatic crystals, resembling Glauber's salt in form. Collected by means of a Bunsen's pump, and dried on a porous tile, they were found to have the composition of ferrous anhydrosulphate, FeS_2O_7. Exposed to moist air, they absorbed water, and gave a salt of the composition $FeSO_4,6H_2O$, but, when treated with water, they yielded crystals of ordinary green vitriol, $FeSO_4,7H_2O$. The author is engaged in the examination of the precipitates produced by oil of vitriol in solutions of other metallic sulphates.

The PRESIDENT having thanked the author for his communication, Dr. C. R. A. WRIGHT read a paper "*On the Hydrochloride of Narcein*," in which the author said he could corroborate Petit's statement that, in order to obtain the normal hydrochloride of narcein, it was necessary to have a large excess of hydrochloric acid. With 8 or 10 equivs. of the latter, the salt was obtained, apparently having the composition $C_{23}H_{29}NO_9,HCl,2\frac{1}{2}H_2O$. When this was dissolved in fifty times its weight of boiling water, fine filamentous crystals were formed at 35°, having the composition $6(C_{23}H_{29}NO_9)HCl$. On thoroughly washing these with cold water, they lost hydrochloric acid, leaving a body of Petit's formula, $10(C_{23}H_{29}NO_9)HCl$, but it is doubtful if this is a definite compound, as it still loses hydrochloric acid by repeated crystallisation. Owing to the obstinacy with which the hydrochloric acid adheres to narcein, it has not hitherto been practicable to obtain it absolutely free from chlorine. This, the author thought, might be due to the presence of a chlorine derivative of narcein analogous to chlorocodide, but no evidence of the existence of such a body could be obtained, the action of strong hydrochloric acid on narcein, giving rise to a hydrochloride of a base having the formula $C_{23}H_{27}NO_8,HCl$. The new base is amorphous, sparingly soluble in ether, and its salts yield a dark blue-purple colour with ferric chloride.

The PRESIDENT said they were much obliged to Dr. Wright for his paper on this portion of his researches on the opium bases.

The meeting finally adjourned until Thursday, Jan. 15, 1874, when the following papers will be read:—"On the Action of Trichloracetyl Chloride on Amines (I., Action on Aniline)," by Dr. Tommasi and Mr. R. Meldola. "Researches on the Action of the Copper-Zinc Couple on Organic Bodies (Part V., On Ethyl Bromide), by Dr. J. H. Gladstone and Mr. A. Tribe.

NOTICES OF BOOKS.

Quantitative Chemical Analysis. By Dr. C. REMIGIUS FRESENIUS. Sixth Edition, Translated from the Fifth German Edition by A. VACHER. London: J. and A. Churchill.

THE chemical world at large has long ago come to a conclusion as to the merits of the original work of Fresenius, and we, at least, see no grounds for appealing from its verdict. In noticing the present edition, our business, therefore, is merely with the translator, and the manner in which he has fulfilled his duties. When speaking of the fifth English edition, we had occasion to express our disappointment at its wide departure from the original. We learn from Mr. Vacher's preface to the work now before us that Dr. Fresenius took a similar view. To abridge or condense a book of this kind is only possible by impairing its usefulness, and by omitting more or less those seemingly minute, but not the less necessary, precautions which the author's wide and prolonged experience had suggested. We are therefore unfeignedly glad to find the "Quantitative Chemical Analysis" once more appearing in an English dress unabridged, and with its known and approved peculiarities. We confidently expect for this edition a wide and rapid sale among students and chemists who have been unable to meet with a copy of the fourth edition, and who all will rejoice with us to find Fresenius "is himself again."

CORRESPONDENCE.

SEPARATION OF IRON AND ALUMINA.

To the Editor of the Chemical News.

SIR,—The separation of alumina from iron is occasionally a point of slight difficulty with those who are unable to procure pure alkalies; it may be of interest to some to be made aware that a boiling solution of barium hydrate answers the purpose perfectly well. The iron sesquioxide may be dissolved in sulphuric acid, reduced with zinc, and titrated by permanganate or bichromate, and, the barium having been extracted by similar means from the filtrate, the precipitated barium sulphate is to be separated by decantation and washing, when, in the liquid thence obtained, the aluminic hydrate is precipitated by ammonia with the usual precautions. The estimation of the iron, if performed volumetrically, is scarcely, if at all, interfered with by the presence of barium sulphate, so that it is scarcely worth while to separate the latter before titration.—I am, &c.,

F. MAXWELL LYTE.

Chemical Laboratory, 6, Cité de Retiro,
Rue de Faubourg St. Honoré, Paris,
Dec. 17, 1873.

ANALYSIS OF CIGAR-ASH.

To the Editor of the Chemical News.

SIR,—I am obliged to Mr. Simmonds for calling attention to the error in the analysis of cigar-ash. I find that 5·764 per cent of sodium sulphate has been omitted, which will bring the result to 100.—I am, &c.,

A. PERCY SMITH.

Hertford, Dec. 15, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Bulletin de la Societe Chimique de Paris, tome xx., Nos. 8 and 9, November 5, 1873.

Detection of Blood Spots by means of Tungstate of Soda.—M. Sonnenschein.—Tungstate of soda, strongly acidulated with acetic or phosphoric acid, throws down albumenoid matters from very dilute solutions. These precipitates, insoluble in a large excess of water, dissolve in alkalies, especially if hot. If defibrinated blood is treated with this salt, a red-brown precipitate is formed, which becomes clotty on boiling. All the colouring matter is thrown down. To detect blood spots by this means on clothing, &c., the suspected portion is cut off, and, after having been treated with distilled water, the filtered solution is precipitated with the above reagent. The precipitate, washed and treated with ammonia, takes a reddish-green colouration. If phosphoric acid is present, it must be carefully washed away before treating the precipitate with ammonia.

Toxicological Detection of Phosphorus in Presence of Fatty Bodies.—Van Bastelaer.—The liquid is repeatedly shaken up with ether; the ethereal extract is evaporated, under protection from dust. At the end of the operation, a few drops of distilled water are added to hinder the action of the air upon the phosphorus. Under the water is deposited a liquid globule, composed of phosphorus and fat. This is placed in a small tube, and agitated with strong ammonia at 21°; the ammonia is removed by washing, first with very dilute sulphuric acid, and then with water. The phosphorus then remains, with all its physical and chemical properties.

Hepatic Ferment.—M. Wittich.—The author proves that the hepatic ferment exists in the cells of the liver, and is not derived from the blood traversing that viscus.

On Albumenoids.—M. Eichwald.—The author combats the theory of Schmidt on the coagulation of fibrin. He proves experimentally that coagulation may take place when the paraglobulin or plastic fibrin has been completely removed, and is even hastened by the action of carbonic acid. Fibrin is thrown down on neutralising the blood with carbonic acid. The albumenoids are composed of one and the same substance, modified by its combinations with colloidal and crystalloidal bodies.

Casein and Coagulation.—F. Soxhlet.—The author considers the alkaline aluminates, and casein as identical. He ascribes the coagulation of milk under the influence of pressure to the transformation of milk-sugar into lactic acid. This view is combatted by M. Heintz in another paper on the same subject.

Application of the Waste from the Manufacture of Bone-Gas to the Preparation of Pure Sal-Ammoniac.—J. V. Divis.—The purification of the ammoniacal salts from the waste of bone-gas works and animal-charcoal works is rendered difficult by the presence of empyreumatic animal matters (Dippels's oil). The crude products have to be re-sublimed, which materially adds to the cost of production. The neutralisation of the condensation-waters with hydrochloric acid occasions a nuisance on account of the presence of ammoniacal sulphide and cyanide. The author has found a method of purification which may be used even in sugar-works which prepare their own bone-black. According to the quality of the bones, from 8 to 10 per cent of ammoniacal water may be obtained, containing from 7 to 9 per cent. of actual ammonia. The yield of bone-oil is 1·7 to 2 per cent. The ammoniacal waters are collected in old petroleum casks, and after standing for two days the supernatant oil is decanted off. The water is then gently heated, and exactly neutralised with hydrochloric acid, after having been mixed with a concentrated solution of chloride of calcium to decompose carbonate of ammonia, without which there would be liberation of gas. Carbonate of lime is deposited in abundance, and its precipitation clarifies the liquid. After some hours it is decanted, when the sediment forms a good manure. The chloride of calcium must not be in excess, but rather slightly deficient. The decanted solution is clear and yellowish. It is heated to boiling in a sheet-iron tank, which causes the rest of the impurities to separate out when they are skimmed off. The boiling liquid is then filtered over a mixture of wood charcoal, animal charcoal, and coke placed in a double-bottomed cask. Finally the clear liquid is evaporated in shallow pans, the vapours given off being forced through the ash-grates of the furnaces. The sal-ammoniac thus obtained contains 95·3 per cent of true chloride of ammonium, and 4·2 per cent of water.

Use of the Aluminate of Soda to Preserve the Back-Cloths used in Calico Printing.—M. Kielmeyer.—This invention refers especially to printing aniline blacks. The author dresses these cloths with aluminate of soda thickened with starch. This salt, by its alkaline reaction, destroys the aniline black, so that the piece may be perfectly purified after having served as back-cloth, and may even be ultimately printed. The use of aluminate of soda presents another advantage; the aniline black is destroyed on the "wrong side" of the pieces that are being printed, and as the black does not penetrate through the cloth, its fibre is less injured.

Tartar Substitute in Grain Dyeing.—M. Malfait.—This project has been commented on in Reimann's *Färber Zeitung*, and a notice of it extracted from that journal.

Antimony Blue.—C. Kraus.—The author obtains this colour by the improved process of boiling tartar-emetic with yellow prussiate of potash, and adding hydrochloric acid. The same colour may be produced, though less easily, by boiling the prussiate with hydrochloric acid, without the antimony. The antimony does not enter into the composition of this colour, but merely facilitates its formation, and may be replaced by mercury. The blue colour is, of course, merely a modification of Prussian blue, and has no right to the name of "antimony blue."

New Aniline Colour (Cinnamon-Brown).—This colour yields, on wool, silk, and cotton, a fine brown, which may be varied at pleasure by the addition of blue, red, or yellow dye-wares. On silk and wool it is applied without mordant. It is dissolved in warm water, and filtered after cooling. For silk it is acidulated with tartaric acid. For wool, 1 kilo. of sulphate of soda, and 250 grammes of sulphuric acid are taken to 20 kilos. of wool. The dyeing is performed at a boiling heat. Cotton is previously mordanted with tannin. Cinnamon-brown is obtained by means of one of the products formed in the manufacture of magenta. It is an acid salt of crysotoluidin, $C_{21}H_{21}N_3$, a base derived from toluidin by the elimination of hydrogen—$3C_7H_9N - 3H_2 = C_{21}H_{21}N_3$. The base is insoluble in water, and is separated from the solution of its salts by alkalies, in the form of a light yellow precipitate. Its neutral salts are sparingly soluble in boiling water, which splits them up into an insoluble basic salt and a soluble acid salt. The solution of the acid salts is of a yellowish-brown colour; the alcoholic solution of the free base is a pure yellow. This shade is obtained on dyeing in a bath of the acid salt mixed with an alkali.

Manufacture of White-Lead, and Accidental Products which may be Formed on the German Method.—C. von Weise.—The German process for white-lead making is a modification of the Dutch. Sheets of lead are exposed, in spacious and closed chambers, to the joint action of air, vapour of water, and acetic acid, and of carbonic acid. The product is greyer than that produced by the Dutch method, and covers as well. It

covers better than the white-lead of the Clichy process; it is denser, finer in grain, and never crystalline, and requires less oil for painting. The German process yields a product more constant than the Dutch, as it is easy to regulate the access of air, of carbonic acid, and of the acetic vapour. Nevertheless, the progress of the operation presents certain difficulties which require much experience, and products may be formed which affect the whiteness and the covering properties of the ceruse. The best ceruse has the composition $2CO_2PbO+PbO,H_2O$. There are good specimens containing rather less hydrate of lead, but if the proportion of the latter becomes too low, the product is hard and unfit for use. In general, a ceruse is better the more hydrate of lead it contains, within certain limits. The injurious influence of an excess of carbonic acid is due to the crystalline structure which the product assumes. A sample of crystalline ceruse has a composition very like that of the neutral carbonate. The residues, likewise very hard, obtained by sifting and levigating the crude product approximate also to this composition, and are useless as a colour. In fine, the qualities of white lead may be classed according to their composition :—

	PbO.	CO_2.	H_2O.
1. First quality	86·80	11·16	2·00
2. Second quality	86·24	11·68	1·81
3. Third quality	86·03	12·28	1·68
4. Residues, very bad	84·69	14·10	0·93
5. Abnormal product, useless..	83·47	16·15	0·25

The products too rich in carbonic acid are grey. Another cause affecting the whiteness of the product is the formation of anhydrous oxide of lead, which is red or yellow. A sample of this red product gave on analysis :—

Oxide of lead	93·70
Carbonic acid	5·31
Water	0·90
	99·91

Or 32·22 per cent carbonate of lead, 12·05 of hydrate, and 55·64 of anhydrous oxide. This anhydrous oxide is produced when the supply of acetic acid and water in the chambers is deficient.

Utilisation of Residues of Manganese in the Glass Manufacture.—The solutions of manganese, resulting from the manufacture of chlorine, may advantageously replace peroxide of manganese in glass works. The acid liquid is poured into a large wooden vat, which it fills to the height of one-third, and ground carbonate of lime is added. When the effervescence is over, the rose-coloured solution is decanted, free from iron, which has been precipitated by the chalk. The solution is now placed in a second vat with slaked lime, so as to produce a thick mixture. This turns brown rapidly on the surface. It is dried, and calcined in contact with air, till the brown colour is completely developed. The residue is then ground, and washed with water to remove the chloride of calcium.

MISCELLANEOUS.

A Christmas Puzzle for Chemists.—Mention an inorganic compound having for its distinctive name a word of nine letters, five of which are the vowels a, e, i, o, u, disposed in their alphabetical order.

University of London.—The following are lists of the candidates who have passed the recent Examinations :—*M.S. Examination* (Pass List).—Rickman John Godlee, B.A. (Gold Medal), University College. *B.S. Examination* (Pass List).—First Division. T. Barlow, B.Sc., University College; H. Colgate, University College; R. C. Lucas, Guy's Hospital; C. A. Rayne, University College; E. M. Skerritt, B.A., University College. *Examinations for Honours*—(B.A. and B.Sc. conjointly). *Logic and Moral Philosophy*—First Class. F. Gotch, B.A. (Scholarship), University College; B. J. Leverson, B.A., University College. Second Class. H. S. F. G. Chuckerbutty, B.A., University College; R. Lovett, B.A., Cheshunt College, and J. C. Witton, B.Sc., Royal School of Mines (equal); E. R. Hollings, B.A., private study, and L. M. Simmons, B.A., City of London School and private tuition (equal). Third Class. A. G. Savile, B.A., private study, and J. W. Thompson, B.A., University College (equal); W. A. Foxwell, B.A., Wesleyan College, Taunton, and H. Norburn, B.A., private study (equal). (B.Sc. only). *Chemistry*.—First Class. A. S. Napier, Owens College, and J. C. Witton, Royal School of Mines (equal). Third Class. J. A. Hullard, University College, and L. Lyell, private study (equal). *Geology and Palæontology*.—Second Class. H. S. Roberton, Old Trafford School and Owens; S. H. Vines, Christ's, Cambridge, and Guy's Hospital; L. Lyell, private study; A. W. Fuller, Owens and Emmanuel, Cambridge. Third Class. W. B. Worthington, Owens College; A. S. Napier, Owens College. *Zoology*.—First Class. A. M. Marshall (Scholarship), St. John's College, Cambridge. Second Class. S. H. Vines, Christ's, Cambridge, and Guy's Hospital; L. Lyell, private study.

Fletcher's New Low-Temperature Burner and Foot-Blower.—We have previously had occasion to notice some of Mr. Fletcher's improved appliances for the production and application of heat from gas. The "new low-temperature burner" by the same inventor seems likely to be not less widely appreciated. It gives a range of temperature varying, at the will of the operator, from a mere current of warm air to bright redness, and so perfectly under control that it may be advantageously used for drying, for prolonged digestion and evaporation, and a variety of other operations. It is considered likely to supersede to a great extent hot-air baths. water-ovens, sand-, oil-, water-, steam-, and solution-baths—apparatus which are all, from well-known reasons, more or less objectionable. We learn, in proof of the regular and equable character of the heat, that a common glass bottle may be placed on the tripod above the wire gauze at the top of the apparatus, and heated to any temperature that may be desired without the risk of breakage. When very low temperatures are required, below, or not much exceeding, the boiling-point of water, the gas is lighted through the aperture in the side of the furnace, and burns below the wire gauze. If a red heat is wanted, the light is applied above the wire, where the gas burns with a clear blue flame. By means of a specially adapted "blast-tube," the temperature can be raised to a bright yellow heat, bordering upon full whiteness, being regulated by the respective quantities of air and gas supplied. The "foot-blower" is an improved bellows which may be used with any kind of table blowpipe or laboratory blast-furnace; it appears convenient for working, well arranged, and not likely to get out of order.

NOTES AND QUERIES.

Petroleum.—A cellar has had petroleum stored in it. Is there any effectual method of getting rid of the smell? If you can help me to a solution of this difficulty you will oblige.—FRANK P. PERKINS.

Discharge for Chlorine.—Can any of your numerous readers informe me which is the least expensive discharge for chlorine from textile fabrics without affecting the colour?—A CONSTANT READER.

Sulphide of Sodium in Black-Ash.—(Reply to "A Subscriber.")—200 grs. in fine powder, ½ litre H_2O; temp., 44° C. Allow to stand for, say, two hours, with frequent stirring; filter. 250 c.c. (= 100 grs. dry black-ash) for sulphides, decant into basin, add standard solution ($PbNO_3$) till all the sulphides are precipitated; nitrate of lead paper as test.—W. SIMMONDS.

Fuller's Earth and Resin Oil.—Crude resin oil being generally turbid, Fuller's earth, as well as other varieties of clay, is sometimes used as a clarifier. The powdered clay is mixed with the oil, stirred, and, when it has subsided to the bottom of the tank, the oil is filtered and comes out quite clear. But this is not literally *refined* oil. Crude resin oil contains a certain proportion of undecomposed resin, pyroligneous acid, liquid hydrocarbons of widely different boiling-points, also solid homologues of naphthalin. To refine this crude oil it is necessary to re-distil it with slaked lime, and separate the successive products of the distillation. Having had considerable practical experience in the matter, I could give A. K. C. any further imformation he might require.—P. C.

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